MACHINERY

Design—Construction—Operation

Volume 43 NOVEMBER, 1936 Number 3

PRINCIPAL ARTICLES IN THIS NUMBER

FOR COMPLETE CLASSIFIED CONTENTS, SEE PAGE 232-H

The Accuracy and Performance of Machine Tool Spindles *By H. Törnebohm* 169

How Grinding Wheel Improvements Have Influenced Shop Practice ..... *By Ralph M. Johnson* 178

A Honing Machine Builder Practices What He Preaches 182

Editorial Comment 186
Better Machines and Better Advertising Spell Progress—Wages are Reduced by Mounting Costs of Government

Cam Slots Formed in Die-Casting by Loose Die Parts *By Charles O. Herb* 190

Trepanning High-Speed Steel Sheets ..... *By F. D. Mondin* 192

Recent Developments in Methods and Equipment for Plastics *By Herbert Chase* 201

Machine Tool Builders Discuss Problems of the Industry 208

Large Farrel-Sykes Gear Generators for Soviet Russia 211

December MACHINERY will deal with many unusual mechanical problems. It will review present developments in internal centerless grinding practice and present articles on how to design dies for metal boxes with folded corners; how to drill evenly spaced holes 0.010 inch in diameter on a production basis; how to design forming mills for U-shaped sections; and how to lay out fixtures for machining irregular shapes by profile milling. Other subjects covered will include recent developments in hard-facing; reasons for the variation in size of tapped holes; and magnesium die-castings, as well as articles on tools, fixtures, and mechanisms.

DEPARTMENTS

Engineering News Flashes 184
Ingenious Mechanical Movements 187
Design of Tools and Fixtures 195
Questions and Answers 199
Ideas for the Shop and Drafting-Room 200
Materials of Industry 206
New Trade Literature 213
Shop Equipment News 215

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Product Index 148-164

Advertisers Index 167-168

CIRCULATION 15,158

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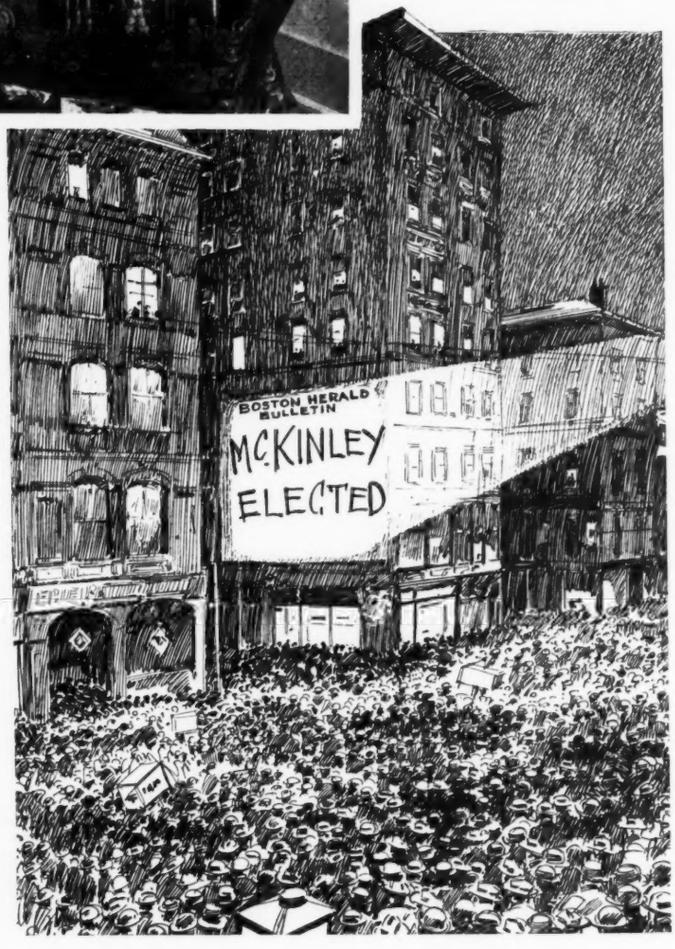
The

Below: Scene at the Boston Herald Announcement in 1896 of the election of William McKinley to the Presidency of the United States. At that time Lodge & Shipley, in their third year, were already establishing their name as a synonym for fine lathes.

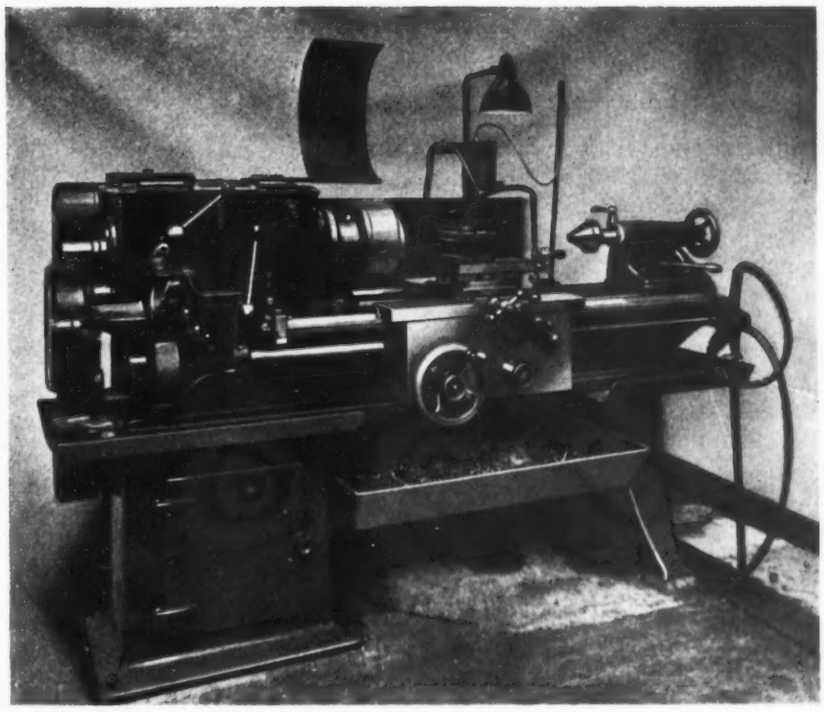


LODGE & SHIPLEY LATHES

MACHINERY

Volume 43 NEW YORK, NOVEMBER, 1936 Number 3

The Accuracy and Performance of Machine Tool Spindles



An Investigation into the Reasons Why Machines Apparently Identical in Design and Construction are not Always Equal in Performance

By H. TÖRNEBOHM
S K F, Gothenburg, Sweden

THE increasing use of high-speed cutting tools during recent years has brought about a demand for higher spindle speeds, together with increased rigidity of machine tools and their spindles. The higher speeds have created added interest in the application of ball and roller bearings to spindles to meet the requirements for greater accuracy and rigidity.

Among practical shop men, it is a well-known fact that machine tools have individual peculiarities, even when the machines are of identical make, size, design, age, and construction. As it is logical to assume that these individual properties of identical machines may result from the spindles and their bearings, the author has given this question special study, having had at his disposal a large number of machines of identical construction.

These machines were manufactured at approximately the same time and were as nearly the same as possible. In spite of this fact, the machines,

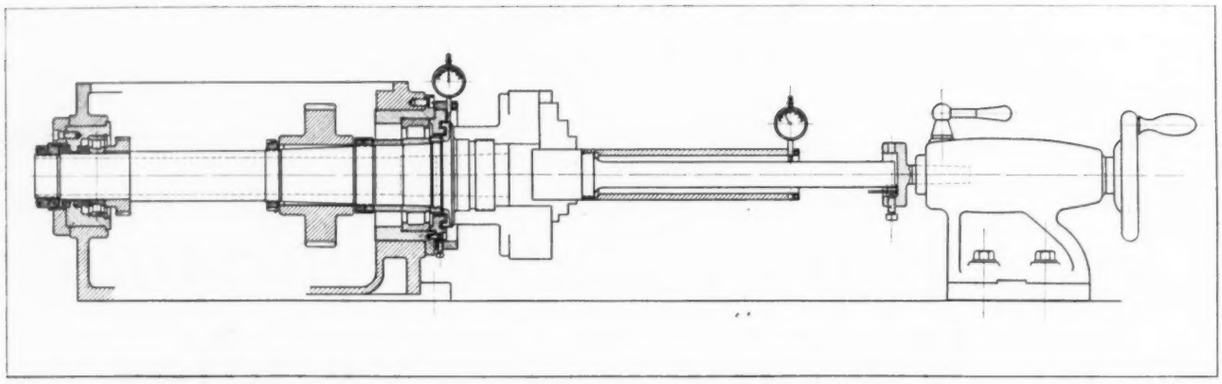


Fig. 1. General Arrangement Used for Testing the Run-out of Machine Tool Spindles

according to the shop men, were not equal in performance; some of them were doing better work than others. This condition prompted an analysis of all the factors influencing spindle mountings. The results obtained from this analysis are briefly presented in this article.

If one considers the properties that a spindle should have to obtain the best results, it is found that the three following main conditions must be fulfilled:

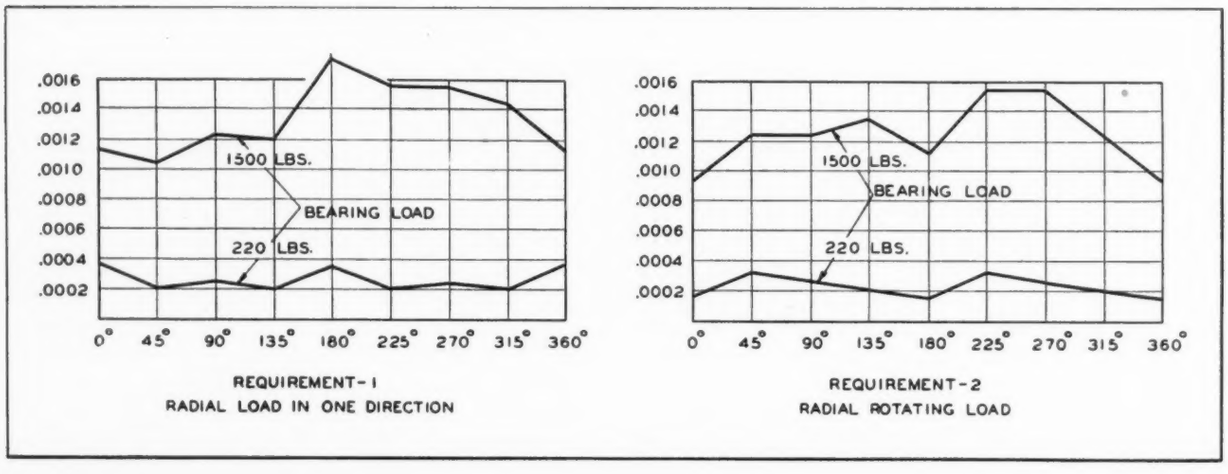
1. *True running under radial load in one direction*—This means that the spindle nose should run as true as possible around its center under heavy, light, or changing loads. As occasionally changing load conditions arise, due to projections on the work, or to the fact that the material being cut is not homogeneous, or to hard spots, Condition (1) will be best fulfilled if the spindle and bearing spring as little as possible. On the other hand, it is evident that concentricity can be secured in the case of "load in one direction" even if play is present in the bearings. Condition (1) is of importance for outside and inside turning, surface milling, and similar operations.

2. *True running under rotating load*—This means that the spindle should run as true as possible around its center, even if the load rotates with the spindle, and irrespective of whether it is subjected to a heavy or a light load. Condition (2) is particularly important with boring mills and similar machines. This condition can be fulfilled only if the bearing is rigid and free from noticeable internal looseness.

3. *Axial rigidity*—The axial position of the spindle must be as constant as possible, even under changing thrust loads. Condition (3) is particularly important in facing, grooving, threading, and other turning operations in a lathe—also in milling machines when facing with end-mills.

From the foregoing paragraphs it is evident that a machine may be suitable for a certain type of operation, but not for others. One machine may fulfill one or two of the requirements mentioned, but not the third, while another machine may fulfill the third and not the others. If it is essential that a machine be as generally applicable or universal as possible, all three requirements must be fulfilled. To judge the usefulness of a machine tool, we must determine by means of tests to what extent it fulfills the required conditions. It is evident that this cannot be determined by tests made under no-load conditions, and it is likewise clear that some method must be established that will deter-

Fig. 2. Diagrams Showing Run-out of Work-head Spindle of a 16-inch Lathe Equipped with Roller Bearings



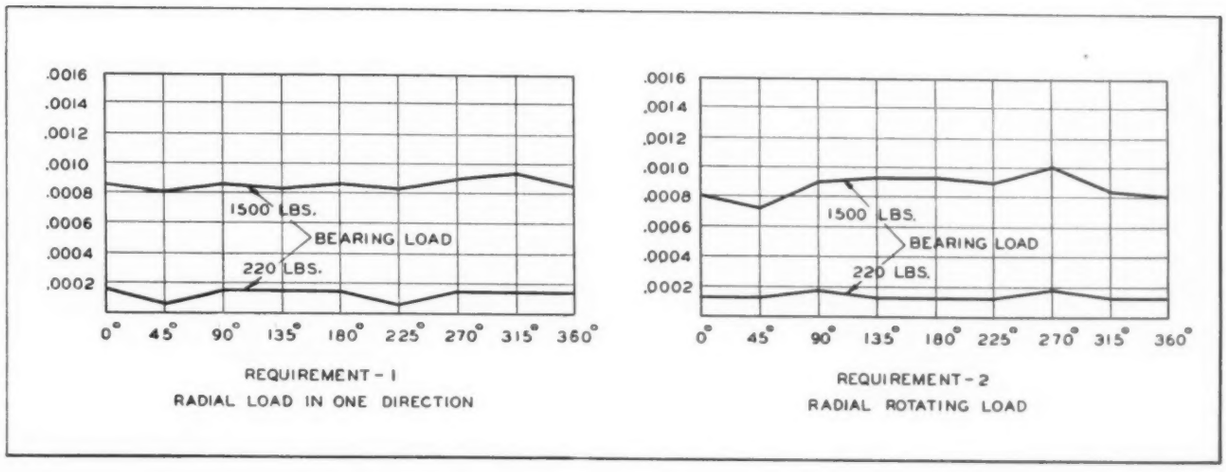


Fig. 3. Run-out of Work-head Spindle of Another 16-inch Roller-bearing Lathe

mine in what respects the machine is or is not efficient.

In the tests and analysis made by the author on lathes and milling machines, the device shown in Fig. 1 was used. This consists of a spring steel rod, so designed that it can easily be held in an ordinary three-jaw lathe chuck. The load on the spindle bearing was effected by a screw arrangement on the tailstock of the lathe. The load can also be applied by means of weights on the rod. In the case of milling machines, as well as some other types of machine tools, a special screw arrangement similar to that illustrated in Fig. 1 can be used. The magnitude of the load is read by means of an indicator located at the proper distance from the spindle nose.

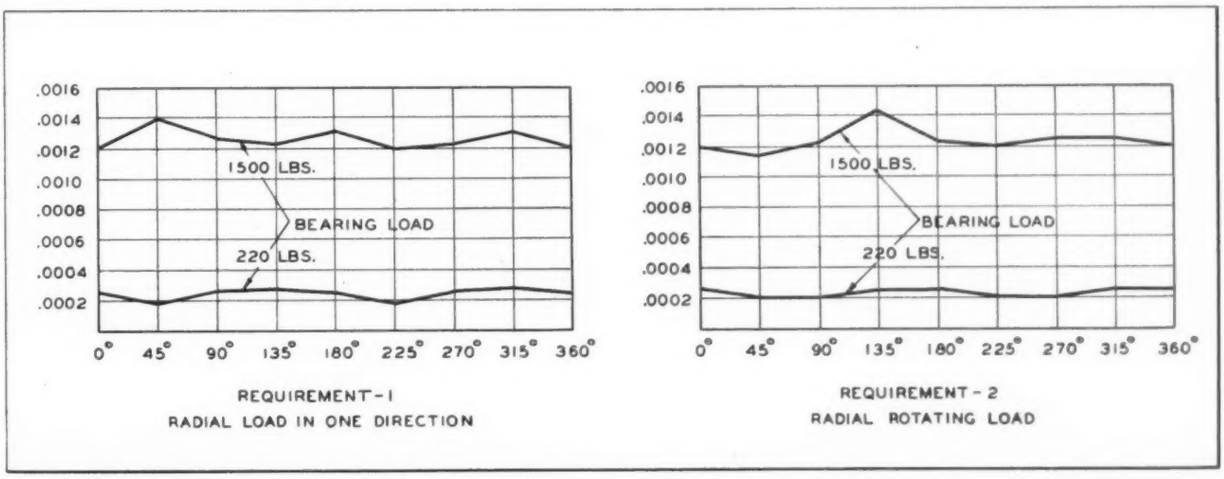
The tube surrounding the rod serves as a holder for the indicator. The comparison between the flexing of the rod and the bearing load can easily be calculated. The springing of the spindle itself, or the concentricity, is read from a second indicator mounted on the spindle head, or, in the case of milling machines, in the base.

During the entire test of Condition (1), both indicators and the loading device can be kept in the locations shown. The run-out will be obtained by repeated loadings and readings at various locations of one spindle revolution.

The tests discussed in the following are based on readings made at 45-degree intervals under two different load conditions—220 and 1500 pounds. In order to visualize the test figures in diagram form, a zero line has been established. While it may be questionable to assume that the spindle has a zero position—that is to say, a fixed position under no load—nevertheless, the diagrams have been prepared on the basis that the zero position is assumed to be the position midway of the extreme positions under a load of plus or minus 220 pounds applied in the same plane.

The tests were first made in one plane which may be called 0 degree, under a load of 220 pounds, and then in a plane of 180 degrees. The measurements were noted and the 0 position was plotted midway between these figures. Measurements were taken in the same manner at 45 and 225 degrees, then at 90 and 270 degrees, and, finally, at 135 and 315

Fig. 4. Further Diagrams Showing Spindle Run-out of a 16-inch Lathe Equipped with Roller Bearings



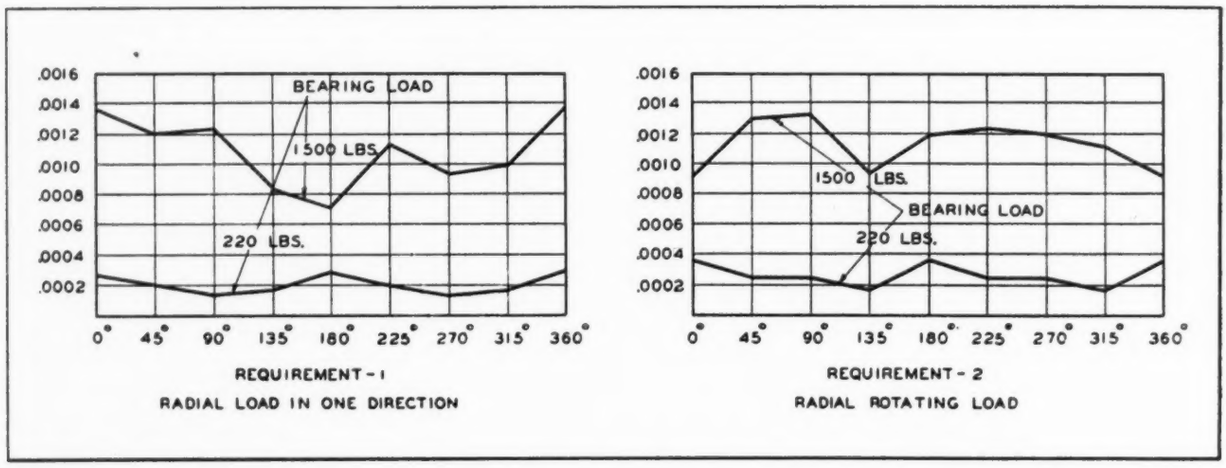


Fig. 5. Diagrams Applying to Still Another 16-inch Lathe Having Roller Bearings

degrees. For each spindle position, measurements were taken under loads of 220 and 1500 pounds.

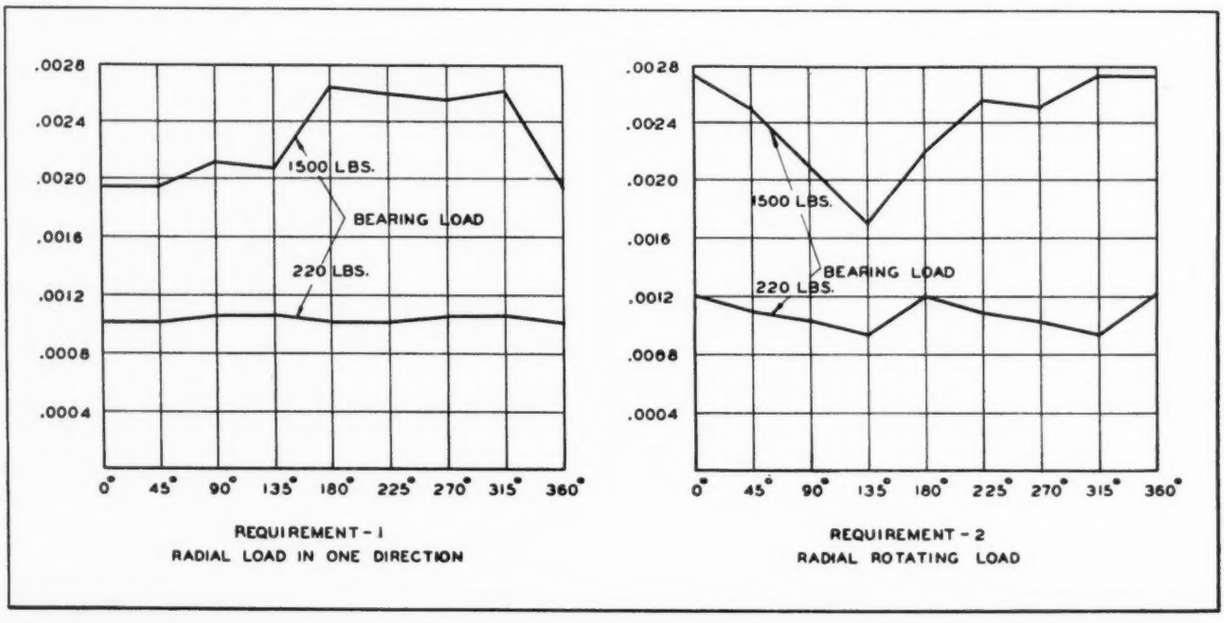
Condition (2) was tested in the same way, except that the spindle was held in the same position and the load applied in the different directions. The two indicators in this case must be changed after each reading to the new angle, according to the direction of the load.

Results Shown by the Tests

All of these tests showed clearly that the relatively good concentricity obtained under light loads was not found under heavy loads. The cause for this must be looked for in the bearing arrangement and not in the strength of the spindle, spindle head, or milling machine frame. After a careful examination of the bearings on the machines under test, it was concluded that the chief cause for the poor results was not due to the roller bearings, but to other conditions in the mounting itself. The conclusion was drawn that out-of-roundness of the bearing housings was the chief reason for the poor results. Incorrect fit between the housing and the outer race of the bearing was also a contributing factor. Loose fits will, of course, give poor results for Condition (2). Out-of-roundness of the bearing housing will give less uniform support of the bearing in the different planes, which accounts for the variations in the magnitude of the springing or flexing of the spindle in the various planes.

To further substantiate these conclusions, additional tests were made on a plain-bearing lathe. One would naturally think that such a test would show especially good results. The results, however, indicated that even plain bearings may show great

Fig. 6. Diagrams Showing Spindle Run-out of a 16-inch Lathe Equipped with Plain Bearings



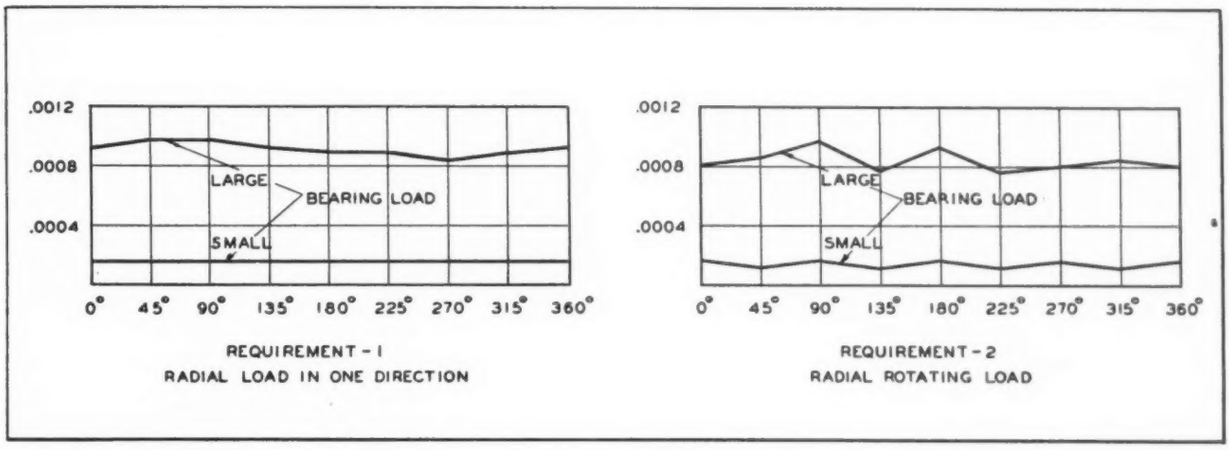


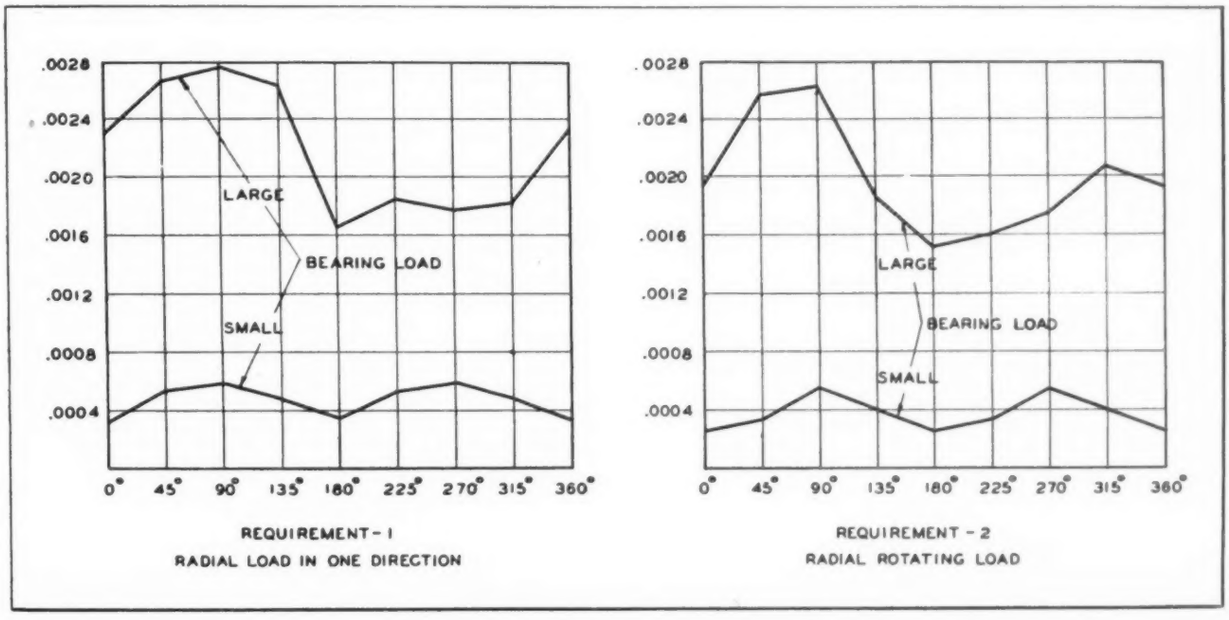
Fig. 7. Diagrams of Run-out of Milling Machine Spindle Having Roller Bearings

fluctuations in magnitude of yield in different directions. The explanation for this is probably found in variations in the clearance between the spindle bearing and the bearing bushing. A low spot of a small fraction of an inch in the housing means, of course, that the bearing bushing is less well supported directly over this low spot, with the effect that increased radial movement of the bearing bushing can take place in that direction when the load is increased from a low to a high value.

Condition (3) was tested by taking indicator readings of the spindle under various axial loads. To set up these loads, a hydraulic jack was used, applied between the spindle nose and the tailstock. These tests also proved the importance of proper fits between the housing and the spindle bearing. It may be sufficient to state that when the thrust load is carried, for instance, by angular contact ball bearings or tapered roller bearings, the races will expand somewhat under thrust load, particularly if they are loosely fitted in the housing. The effect will be that the whole bearing will function more or less as a spring buffer, resulting in poor rigidity.

Of the various diagrams secured in these tests, a few representative ones are shown. Figs. 2, 3, 4, 5, and 6 relate to 16-inch lathes (8-inch center height) of the same make. The machines to which Figs. 2 and 3 refer are identical and have the same bearing mounting. No difference was found in the quality or construction of the roller bearings used. Figs. 4 and 5 show the results obtained with lathes on which other roller bearings were experimentally applied. Fig. 6 applies to a lathe equipped with originally built-in plain bearings. The spindle in this lathe is weaker than in the other lathes. When the lathe was changed over to use SKF roller bearings, the dimensions of the spindle were increased. The fact that the springing shown in

Fig. 8. Run-out of a Spindle of a High-speed Milling Machine Attachment Equipped with Roller Bearings



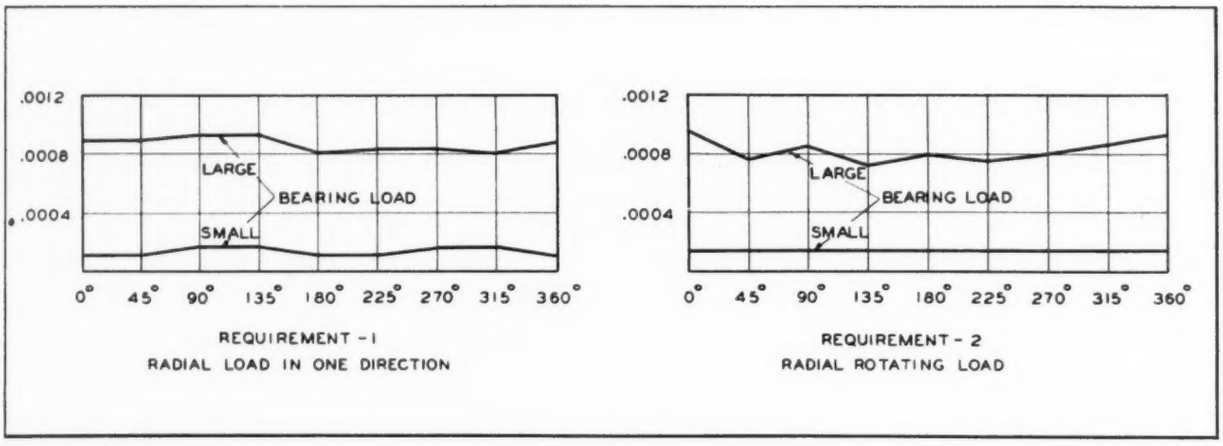


Fig. 9. Diagrams of Run-out of Another Milling Machine Spindle Provided with Roller Bearings

this lathe is greater than that of the other lathes may be attributed to greater deflection of the spindle itself.

It might be mentioned that the lathe to which Fig. 3 applies is particularly favored by the operators. Even before the tests were made, this lathe had been found superior and was reserved for work of a specially accurate character. The reason for this is quite apparent from the diagrams.

Figs. 7, 8, and 9 are a few selected diagrams secured from measurements of several recent American milling machines. Figs. 7 and 9 are from machines, which, according to the shop men, were exceptionally good. The machine to which Fig. 8 applies is of the latest construction and manufactured by a reputable firm. Judging from the diagrams, however, this machine cannot be considered first grade, even though no-load tests indicate acceptable concentricity. It is apparent that such a milling machine would not perform good boring work.

It has just been stated that the poor results obtained with some machines are due to inaccuracy in the machining of the bearing housings, and

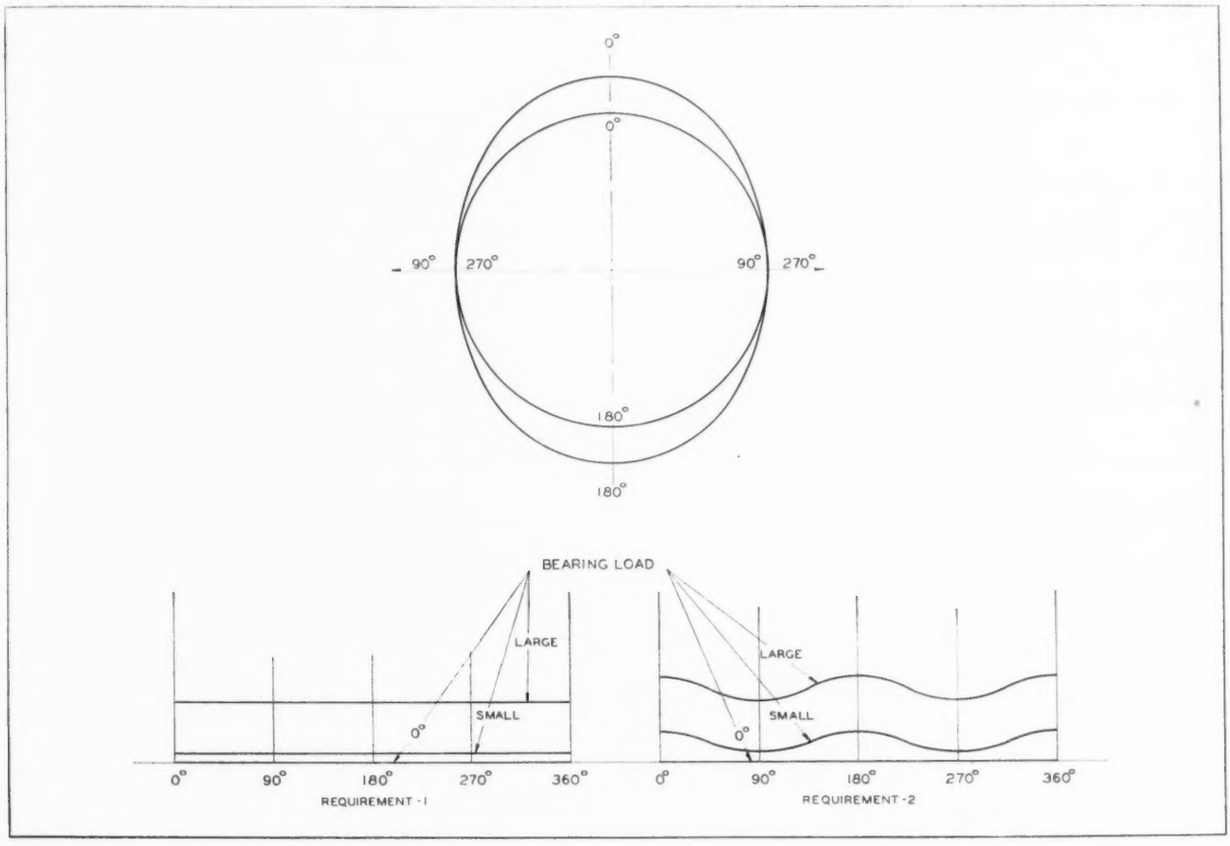


Fig. 10. Analysis of Run-out—Round Spindle in Oval Hole

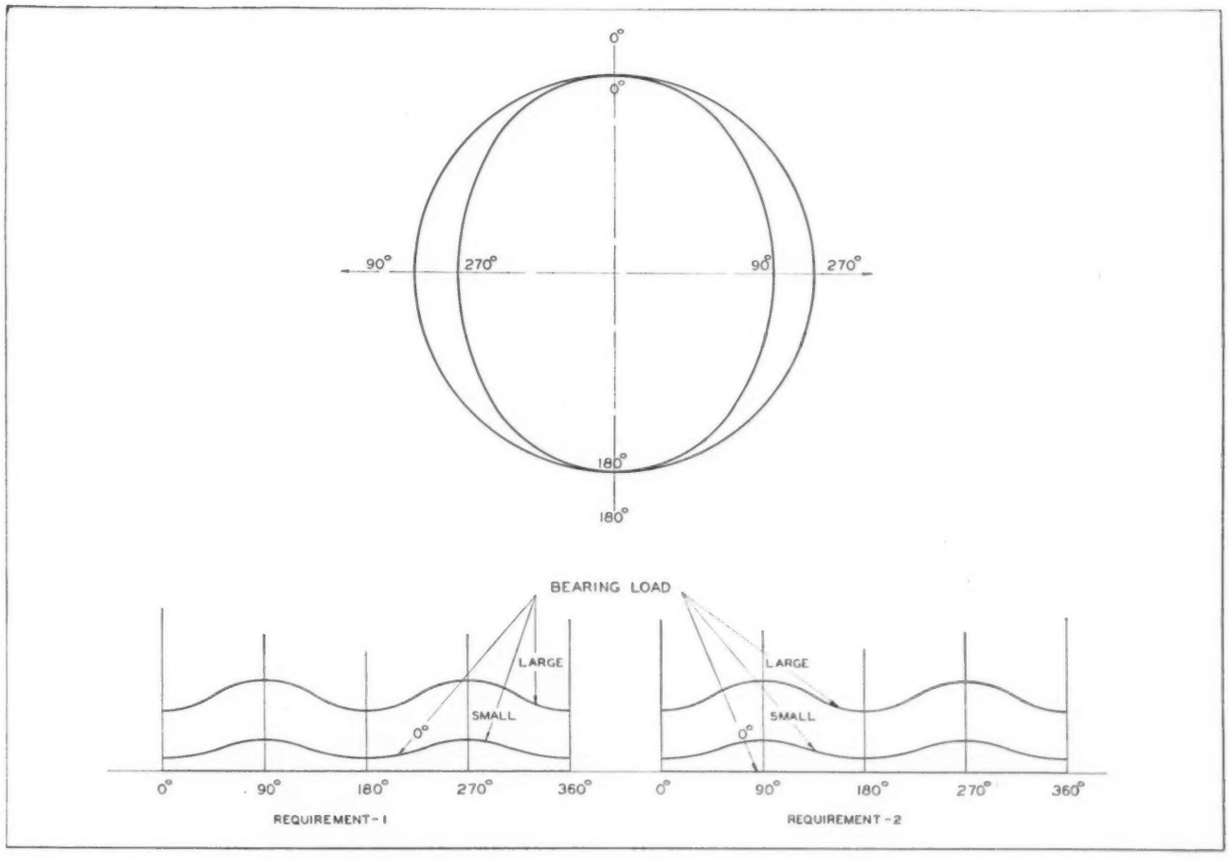


Fig. 11. Analysis of Run-out—Oval Spindle in Round Hole

in particular to out-of-roundness. To clarify and substantiate this, and also to assist in interpreting the diagrams and drawing the necessary conclusions, Figs. 10, 11, and 12 have been prepared.

Some of the Conclusions Reached through the Tests

Fig. 10 presupposes a perfectly round spindle in an out-of-round bearing housing and also applies to a roller-bearing installation where the seat for the inner race of the bearing is exactly round, while the seat for the outer race becomes deformed and oval in shape due to the out-of-roundness in the housing.

Fig. 11 presents a conceivable arrangement where the conditions are directly opposite, or where the bearing housing or bearing roller path is perfectly round, while the spindle or the roller path of the inner race of the bearing is out-of-round. Fig. 12 presents a combination of both possible conditions.

If it is now assumed that the bearings are so adjusted that they are free from internal clearance —that is, that the deflection which occurs is of an elastic nature—it is evident that the spindle movements in a radial direction become of different magnitudes in different directions and that they increase with increasing bearing loads. The diagrams that would result from tests under such conditions would be of a character indicated in the illustrations.

Of particular interest is the fact that, if the bearing were installed as in Fig. 12, such peculiarities might develop that the measurable radial run-out of the spindle would attain its maximum in the same plane with a heavy load as the minimum occurs under a light load, and vice versa. This depends, of course, upon the fact that an out-of-roundness in both the housing and the shaft makes it impossible to prevent play in all directions; but this becomes more or less insignificant in comparison with the elastic deformations under heavy loads. A diagram of this character made under operating conditions is shown in Fig. 5. This indicates that the roller paths of both inner and outer races were out-of-round in this lathe.

The method of measuring and testing described can be advantageously used to check bearing mountings in general, not only in machine tools but also in other types of machines where freedom from vibration, rigidity, and smooth operation are essential.

The experience of one company using ball bearings may be of interest. This company believed for many years that they had cause for complaint in regard to the bearings that were being bought. The bearing manufacturer was permitted to check the tolerances in the housings and shafts in the equipment made by this company, and found that

despite the fact that the tolerances on the outside diameter of the bearing had been considered too great, the company permitted working tolerances three or four times as great as those specified. It was found possible to obtain much lower operating temperatures by using the proper tolerances, and without doing any hand scraping as had been done formerly. Scraping seems to do more harm than good, for if it is not done very carefully, it results in an uneven support, with the consequence that the roller path itself will also become wavy under load or due to the press fit.

From this it is evident that one should not look for magic formulas relating to the selection of bearings and their tolerances. The bearings themselves are not necessarily the measure of spindle performance, nor is their extreme accuracy of the greatest importance. The rigidity of the machine and of the spindle and properly machined shafts and bearing housings are of fundamental importance in obtaining a satisfactory spindle.

Furthermore, it is evident that to check a free-running spindle under no load is not the proper way to determine spindle performance. The work load must be applied and the spindle checked under actual load conditions. It is only when all of the foregoing points have been taken care of that there is assurance of true running of the spindle under variable load conditions, due to variations in the work and increases in production.

Annuities Received by Employes of Westinghouse Electric & Mfg. Co.

Under the Westinghouse Electric & Mfg. Co.'s annuity plan, $386,195 was paid to 1179 pensioned employes in 1935. The average age of those receiving annuities was approximately sixty-six years. The average number of years of continuous service of these employes was twenty-two and one-half years. Since 1929, when the annuity plan was placed in operation, a total of about $1,750,000 has been paid to annuitants.

Due to the increased obligations imposed upon the company by the Social Security Act, the company found it necessary to discontinue its part in the annuity plan on December 31, 1935. Employes still have the privilege, however, of purchasing annuities at favorable group rates.

* * *

Hard-Facing Lathe and Grinder Centers

Tool-steel lathe and grinder centers for machining and grinding crankshafts used to last only 1 1/2 days at a Detroit plant. When a tip of Stellite was welded to the point, the centers were found to last nine days and could be renewed continually by further alloy applications.

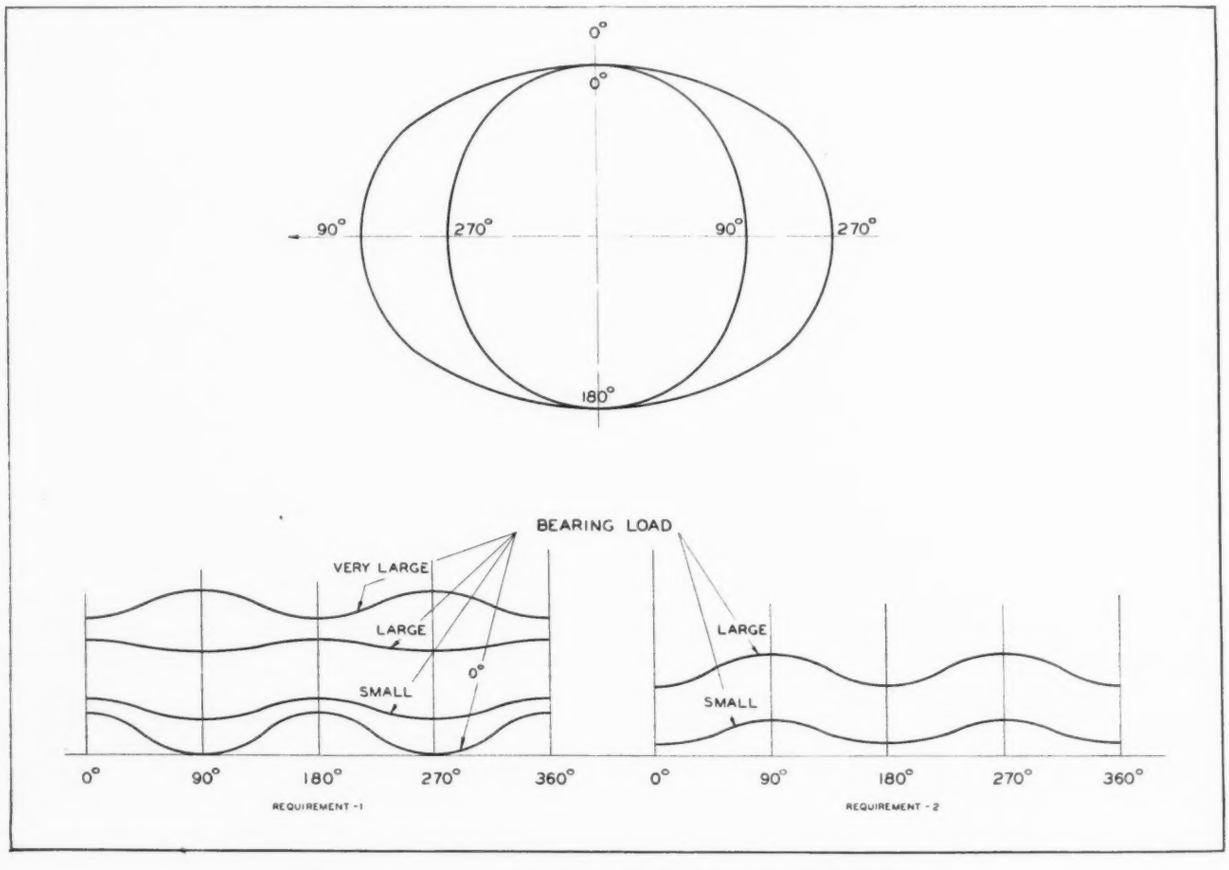


Fig. 12. Analysis of Run-out—Spindle and Hole Both Oval

TYPICAL PROPERTIES OF WROUGHT-ALUMINUM ALLOYS[1]—1

For foot-notes, see Data Sheet No. 334

Alloy and Temper	TENSION				HARD-NESS	SHEAR	FA-TIGUE
	Yield Strength[2] (Set = 0.2%) Lbs. per Sq. In.	Ultimate Strength Lbs. per Sq. In.	Elongation[3] Per Cent in 2 In. Sheet Specimen (1/16 Inch Thick)	Elongation[3] Per Cent in 2 In. Round Specimen (0.505 In. Diameter)	Brinell 500 kg. 10 mm. Ball	Shearing Strength[4] Lbs. per Sq. In.	Endurance Limit[5] Lbs. per Sq. In.
2S-O	4,000	13,000	35	45	23	9,500	5,000
2S-¼H	13,000	15,000	12	25	28	10,000	6,000
2S-½H	14,000	17,000	9	20	32	11,000	7,000
2S-¾H	17,000	20,000	6	17	38	12,000	8,000
2S-H	21,000	24,000	5	15	44	13,000	8,500
3S-O	5,000	16,000	30	40	28	11,000	7,000
3S-¼H	15,000	18,000	10	20	35	12,000	8,000
3S-½H	18,000	21,000	8	16	40	14,000	9,000
3S-¾H	21,000	25,000	5	14	47	15,000	9,500
3S-H	25,000	29,000	4	10	55	16,000	10,000
4S-O	10,000	26,000	20	25	45	16,000	14,000
4S-¼H	22,000	30,000	10	17	52	16,000	14,500
4S-½H	27,000	33,000	9	12	63	18,000	15,000
4S-¾H	31,000	37,000	5	9	70	20,000	15,500
4S-H	34,000	40,000	5	6	77	21,000	16,000
11S-T3	42,000	49,000	..	14	95	30,000	.....
17S-O	10,000	26,000	20	22	45	18,000	11,000
17S-T	35,000	58,000	20	22	100	35,000	15,000
17S-RT	46,000	61,000	13	..	110	36,000	.....
Alclad 17S-T	32,000	55,000	18	..	..	32,000	.....
Alclad 17S-RT	40,000	57,000	11	..	..	32,000	.....
A17S-O	8,000	22,000	24	27	38	15,000	.....
A17S-T	24,000	43,000	24	27	70	25,000	13,500
24S-O	10,000	26,000	20	22	42	18,000	.....
24S-T	43,000	65,000	20	22	105	40,000	14,000
24S-RT	53,000	68,000	13	..	116	41,000	14,500
Alclad 24S-T	40,000	60,000	18	..	..	39,000	.....
Alclad 24S-RT	49,000	62,000	11	..	..	39,000	.....

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TYPICAL PROPERTIES OF WROUGHT-ALUMINUM ALLOYS[1]—2

Alloy and Temper	TENSION				HARD-NESS	SHEAR	FA-TIGUE
	Yield Strength[2] (Set = 0.2%) Lbs. per Sq. In.	Ultimate Strength Lbs. per Sq. In.	Elongation[3] Per Cent in 2 In. Sheet Specimen (1/16 Inch Thick)	Elongation[3] Per Cent in 2 In. Round Specimen (0.505 In. Diameter)	Brinell 500 kg. 10 mm. Ball	Shearing Strength[4] Lbs. per Sq. In.	Endurance Limit[5] Lbs. per Sq. In.
51S-O	6,000	16,000	30	35	28	11,000	6,500
51S-W	20,000	35,000	24	30	64	24,000	10,500
51S-T	33,000	48,000	14	16	95	30,000	10,500
52S-O	14,000	29,000	25	30	45	18,000	17,000
52S-¼H	26,000	34,000	12	18	62	20,000	18,000
52S-½H	29,000	37,000	10	14	67	21,000	19,000
52S-¾H	34,000	39,000	8	10	74	23,000	20,000
52S-H	36,000	41,000	7	8	85	24,000	20,500
53S-O	7,000	16,000	25	35	26	11,000	7,500
53S-W	20,000	33,000	22	30	65	22,000	10,000
53S-T	32,000	38,000	14	20	80	26,000	11,000

(1) Young's modulus of elasticity is approximately 10,300,000 pounds per square inch.

(2) Stress which produces a permanent set of 0.2 per cent of the initial gauge length. (American Society for Testing Materials Specification for Methods of Tension Testing, E 8-33.)

(3) Elongation values vary with the form and size of tension test specimen. Thin sheet has somewhat lower elongation than values for 1/16 inch sheet shown in table. Thicker material, from which standard round tension test specimens (0.505 inch diameter) are tested, may have lower elongation because of the effect of commercial flattening operations on this property.

(4) Single-shear strength values obtained from double-shear tests.

(5) Based on withstanding 500,000,000 cycles of completely reversed stress, using the R. R. Moore type of machine and specimen.

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Sectional Broach for Finishing Curved Edges on Electric Irons

The advantages of sectional broaches were outlined in an article published in September MACHINERY, page 17, which illustrated an unusual broach made by the Ex-Cell-O Aircraft & Tool Corporation, Detroit, Mich., for an operation on aluminum die-castings. Another sectional broach of considerable interest was recently made by the same concern for finishing the long curved edges on the steel plate of electric irons. Fig. 1 shows two of these steel plates before and after the broaching operation.

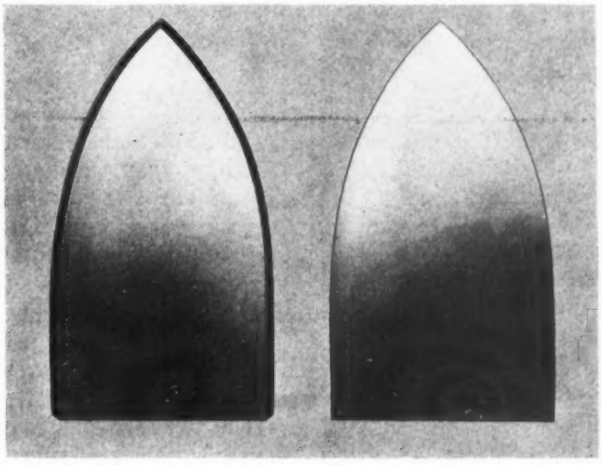


Fig. 1. Steel Plates for an Electric Iron on which the Curved Edges from the Point to the Heel are Finished by Broaching

At no point are the curved edges a true radius, and, in addition, they are tapered outward at an angle of 25 degrees from the bottom surface. The amount of stock removed varies from 1/32 to 3/16 inch. These plates are broached first on one side and then on the other. Two broaches on the same machine and an oscillating fixture expedite the operation.

* * *

Razors made from bronze, according to the Copper and Brass Research Association, have been unearthed in Austria. These razors are over 3000 years old, indicating that shaving is not a modern idea. Although somewhat affected by the passage of time, they still take a keen edge; at least, one of the archaeologists successfully shaved himself with one of these razors.

Determining Cylinder Wear in Automobile Engines

There are three methods for determining cylinder wear in an automobile engine. These methods, according to George H. Keller in *Automotive Industries*, are: Weighing the parts of the engine subject to wear; measuring the parts very carefully; and determining the iron contamination of the lubricating oil used in the engine.

Practically all designers and engineers are familiar with the first two methods. The method of determining the amount of wear from the amount of iron contained in the lubricating oil, however, is not so well known and is a somewhat more complicated process where very accurate results are desired. The best method found up to the present time for determining the iron in a sample of the lubricating oil is by chemical analysis, which involves burning the oil to an ash, dissolving the ash in a chemical, and finally analyzing the resulting solution colorimetrically by means of the sulfocyanide method.

* * *

The present tax on undistributed profits is one law that the business man trained to the rainy day reserve idea can never understand. It presents problems to both large and small concerns, and most especially to those with good current earnings, but no surplus reserve.—*J. H. Jackson in an address before the A. G. M. A.*

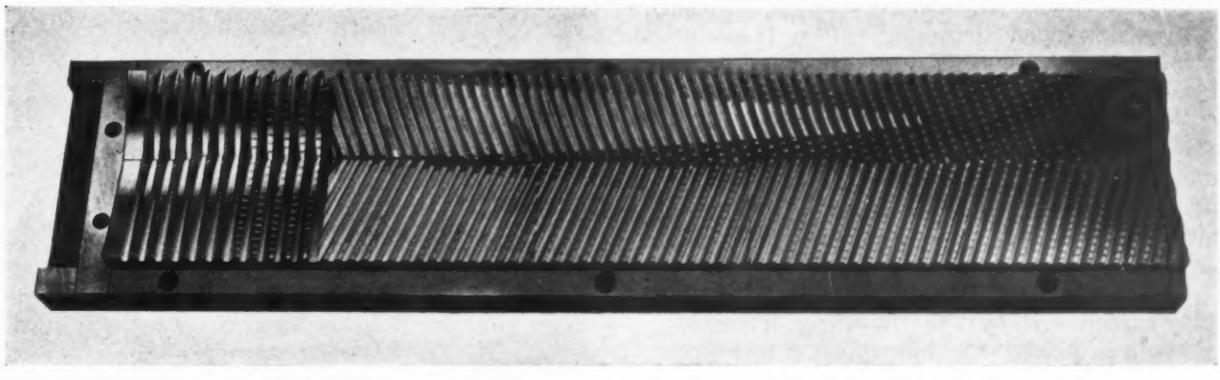


Fig. 2. Broach Made in Ten Sections for Finishing the Curved and Tapered Edges of the Electric Iron Steel Plates Shown in Fig. 1

How Grinding Wheel Improvements

Some of the Recent Developments in Grinding Wheels Have Had a Profound Effect in Changing Machine Shop Methods

Fig. 1. Abrasive Wheel being Used for Cutting off Bar Stock

IN the annals of engineering progress, it does not seem so many years ago since most grinding wheels were made from one kind of abrasive—emery—bonded with clay and vitrified in periodic kilns. A variety of grit sizes and grades were available, but the selection of the wheel for any one grinding operation was limited to a comparatively narrow range of specifications.

Today one of the large grinding wheel manufacturers makes wheels from eight distinctly different types of abrasives, using eight different types of bonds, each with several modifications. Not only is every one of the abrasives available in the ordinary degrees of fineness, but in addition, the very shape of the abrasive grain—the cutting element—is varied to meet different requirements.

In the following paragraphs some of the uses of recently developed grinding wheels will be reviewed. These uses do not include grinding alone, as ordinarily understood, but extend into the fields for which metal-cutting tools have generally been used in the past. And why not? After all, the grinding wheel is very definitely a cutting tool—a cutting tool with an infinite number of cutting edges, if you wish.

High-Speed Cutting-Off Methods as Influenced by the Grinding Wheel

For many years the use of thin grinding wheels was limited to the cutting off of hardened steel or other materials that could not be sawed off with a steel saw. The use of these grinding wheels on softer materials was not economical at the speed at which they were operated, which usually varied from 9000 to 12,000 surface feet a minute. They were not suitable for production tools and they found their field of usefulness restricted to toolroom work.

With the large increase in productivity demonstrated by new, amply powered, abrasive cut-off machines, designed to operate the abrasive cut-off wheel at 16,000 surface feet per minute, came improved wheels. Today, a great deal of attention is being given to abrasive cutting-off operations. Careful studies have been made to determine the best methods to use. In many cases, it has been demonstrated that thin abrasive wheels are not only greater hourly producers than metal saws, but are also more economical. The most commonly used sizes of these abrasive wheels are 12, 14, and 16 inches in diameter by 1/16, 3/32, and 1/8 inch thick.

Tubing of all kinds, including airplane tubing of various shapes and alloys, boiler tubes and condenser tubing, as well as golf-club shafts, bar stock, Catalin products, carbon rods, and sheets of synthetic resins, and dozens of other materials, are now being cut with abrasive wheels more economically and faster than by any other method.

Fig. 2. Airplane Tubing being Cut off at an Angle in an Abrasive Cutting-off Machine

Have Influenced Shop Practice

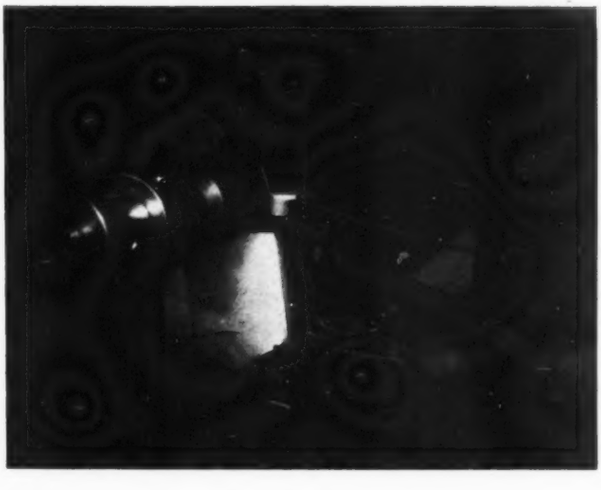
By RALPH M. JOHNSON
Norton Company
Worcester, Mass.

In a few tests that have been made, some remarkable results have been achieved. For example, in the cutting off of 1 1/16-inch S A E 1010 steel tubing with a wall thickness of 0.093 inch, it was found that the average cost for abrasive cut-off wheels per day was $1.05, amounting to a saving in cutting costs for the same number of cuts made of over $10 per day, as compared with previous methods.

In cutting off high-speed steel, tool steel, and cold-rolled steel of various sizes, the net saving in using wheels, as compared with previous methods, has been found to vary from 65 to 85 per cent. In one instance, solid, round, chrome-molybdenum-steel bars, 1 9/16 inches in diameter, were being cut off. Abrasive wheels were being introduced for this purpose. By means of these wheels, the production was increased to three times the former amount, while the expense of cutting tools was reduced from $1.75 per cut to $0.84 per cut, or 52 per cent.

A still later machine development (which was described in March, 1935, MACHINERY, page 393, in an article entitled "Abrasive Cutting-Off Turns Minutes into Seconds") makes it possible to cut off materials that are easily damaged by heat while submerging the material being cut off, as well as the wheel, in water. A common use for such a machine is the cutting-off of glass tubing. Improved finish is obtained, with freedom from chipping.

Fig. 4. Typical Slotting Job Performed by the Use of an Abrasive Cut-off Wheel



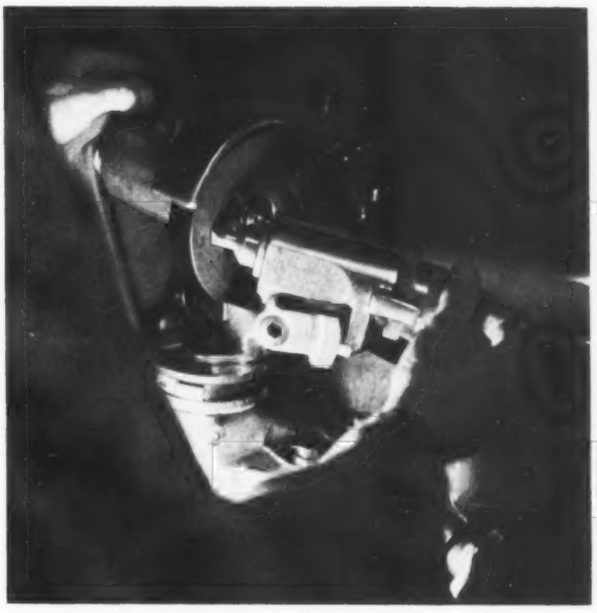


Fig. 3. Lapping a Cemented-carbide Tool on Diamond Wheel

Extremely thin wheels only 0.006 inch thick are used successfully for slitting hard-alloy fountain pen points. Somewhat thicker wheels of larger diameter (varying in thickness from 0.015 to 0.020 inch) are used for cutting expensive materials, such as tungsten rod.

Abrasive cut-off wheels for slotting offer an improvement over present machining practice and are just now beginning to be put into actual production.

The cutting-off of risers of alloy-steel castings is becoming more common by the use of abrasive wheels. A clean, well-finished surface results, often eliminating subsequent finishing operations.

The Growing Practice of Multiple-Wheel Grinding

The constant demand for improved machining methods in the automotive and other high-production metal-working industries has brought about the building of multiple-wheel grinding machines. This practice, in turn, has required the manufacture of special wheels in many cases, and has narrowed the limits within which the grinding wheel specifications must be held.

Fig. 5 shows a machine that grinds the four bearings of a camshaft at a time. This is one of the more recent developments of equipment for multiple-wheel grinding. Four 30-inch wheels are

Fig. 5. A Set of Four Wheels for Grinding Four Bearings of a Camshaft Simultaneously

held within extremely close limits of hardness, in order that they will wear uniformly and produce, with infrequent dressing, bearings within tolerances of 0.001 inch at the rate of 100 shafts per hour.

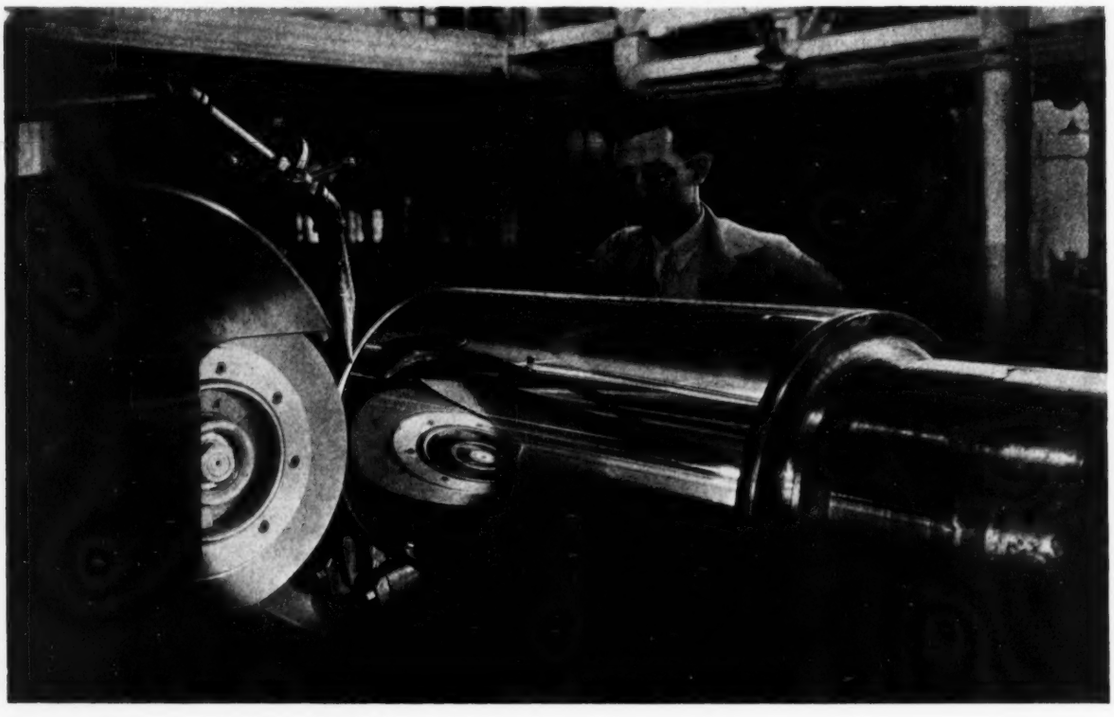
Hardened steel jeweller's rolls for years have been ground and lapped to produce a highly reflecting surface which is duplicated on the surface of rolled gold or platinum foil. The surface on the rolls must be virtually flawless. This requirement was not an easy one to meet, even though the rolls were of small diameter and narrow face. Yet today, it is possible to grind rolls weighing thousands of pounds to such a highly reflecting surface. Some of these rolls are over 30 inches in diameter, with a face width of 84 inches.

Fig. 6 shows a roll of medium size being ground. Not one wheel but four, made of progressively finer grit sizes—46, 150, 320, and 500—are used in successive operations. The final finishing wheel must not only be made of such carefully sized abrasives that it will not produce the tiniest scratch, but must also be of such hardness that it will hold the diameter across the roll face and yet be soft enough to remove the slight amount of stock necessary to eliminate any scratches from the previous wheels.

Only a few years ago, industry began to use cemented tungsten- and tantalum-carbide tools. These tools are so hard that the ordinary aluminum-oxide tool-sharpening wheels made little or no impression on them. After considerable study, wheels were developed that were made of a special green silicon carbide of a soft grade. These were reasonably satisfactory, but it was soon found that in order to grind the new cemented carbides without generating an objectionable amount of heat, which might cause the tool to crack, extremely soft, fast wearing wheels were required.

A new grinding technique had to be developed which improved the sharpening operation, and a brand new type of wheel had to be created before many of the uses to which the cemented carbides

Fig. 6. Highly Reflecting Roll Surface Produced with a 500-grit Diamond Wheel



are now put were possible. This new wheel was made with a peripheral layer of diamonds carefully crushed and accurately sized, and bonded with synthetic resin.

With this wheel, the grinding of cemented carbide took on a new aspect, and it became possible to grind this new material without generating an objectionable amount of heat and in a length of time comparable to that required for sharpening steel tools. It became possible for the first time to surface-grind pieces of cemented carbide and to remove an amount of stock approximately equal to the total in-feed of the wheel. The wear of wheels made from this new material of unprecedented hardness was practically negligible, so that this new type of grinding wheel became economical to use, in spite of the fact that it is made with an abrasive which costs about $2500 per pound—a cost that at first sight might seem prohibitive.

The use of the diamond wheel makes it possible to sharpen cemented-carbide tipped milling cutters without the necessity of indicating each tooth and adjusting for wheel wear. Also, formed tools made of cemented carbide can now be ground in much the same manner as high-speed steel tools. Diamond wheels 0.016 inch thick are available for cutting off tool tips from solid bars of cemented carbide. The precaution of using a copious flow of water on the wheel used for this work results in satisfactory wheel life. For grinding broaches, the advantages of the diamond wheel have been well demonstrated.

Progress Made in Tool-Grinding Methods

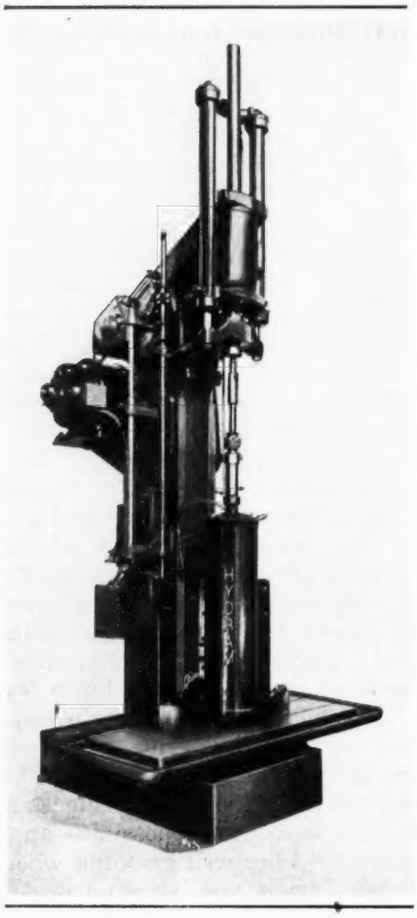
Great progress has been made by the grinding wheel manufacturers in developing wheels to sharpen the multitude of tools made from the better-known tool materials, including Stellite and steels of all kinds. This progress has been a gradual evolution. Emery gave way to manufactured abrasives containing about 90 per cent crystalline aluminum oxide. Later, a special high-purity aluminum oxide was developed, which, because of its free-cutting characteristics, was an extremely important development for use in tool-grinding wheels. The bonds also came in for their share of development, as well as the methods of manufacture. Two major inventions in this field—the B bond (and its recent modification the BE bond) and "controlled structure"—have had a great influence on this advance. The use of the former eliminated some of the defects of earlier bonds, and the latter made possible close control over a previously little considered property of grinding wheels —the structure or abrasive grain spacing.

The foregoing paragraphs are but a few typical contributions made by the grinding wheel industry to improved metal-cutting. Through these developments, increased production, lower costs, better finishes, and an enlarged field of usefulness for many materials have been made possible—an advance, which, except for improved grinding wheels, could not have been economically accomplished.

Fig. 7. Improved Wheel for Sharpening Inserted-tooth Milling Cutters

Fig. 8. Single-point Cemented-carbide Tool being Ground on Diamond Wheel

A Honing Machine What He



HONING has made tremendous strides in the dozen years or so since it was originated. Every automobile manufactured in the world today has its cylinder bores finished by honing. This is true of airplane engine cylinders, as well. Honing is also being widely employed for finishing Diesel engine cylinders, tractor engine sleeves, automobile connecting-rods, roller-bearing races, taper bearing cups, and a variety of parts for electric refrigerators, compressors, washing machines, vacuum cleaners, and many other appliances used in homes and offices.

One of the foremost advocates of honing, from its earliest days down to the present time, has been the Barnes Drill Co., Rockford, Ill. In 1925, this concern produced its first honing machine with a hydraulically reciprocated spindle, and since that time has built several hundred machines based on the same principle. This company recommends honing machines for finishing holes from about 5/8 inch up to 20 inches in diameter whenever accuracy within a few ten-thousandths inch and a high mirror finish are required. Holes of any depth or length can be honed. The process is also being applied successfully to tubing.

That the Barnes Drill Co. firmly believes in what it preaches is proved by the fact that a considerable number of holes in parts for the honing and drilling machines that the company builds are finished by the honing process. The heading illustration on this page shows a hydraulic cylinder being honed for one of the company's Hydram drilling and boring machines. Cylinders such as this are made in three bore sizes, of 6 1/4, 7 1/2, and 10 1/4 inches, and in lengths from 24 to 31 1/2 inches. They are honed to size within plus and minus 0.0005 inch, as well as straight within 0.001 inch.

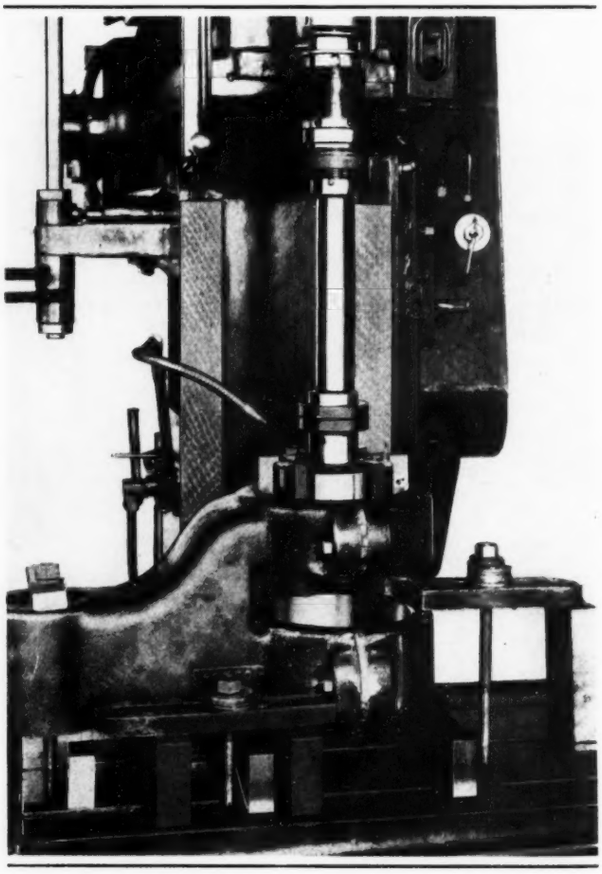


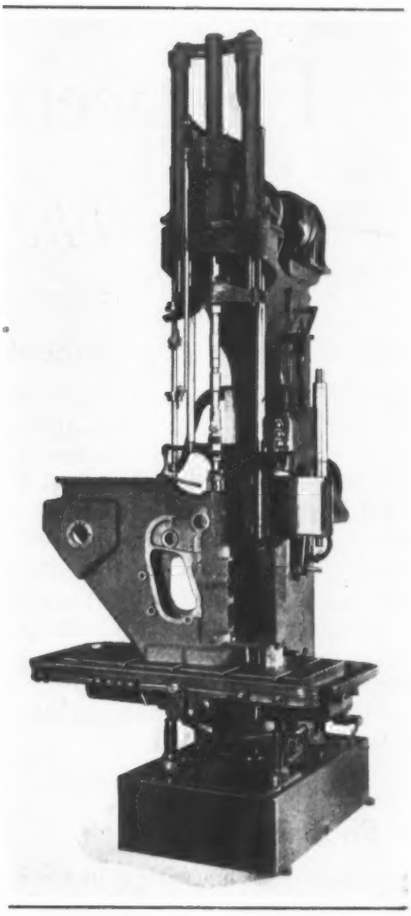
Fig. 1. The Honing of Machine Tool Parts Insures Longer Lasting and Better Fits. This Illustration Shows Bearings being Honed in a Table-arm Casting for a Round-column Drilling Machine

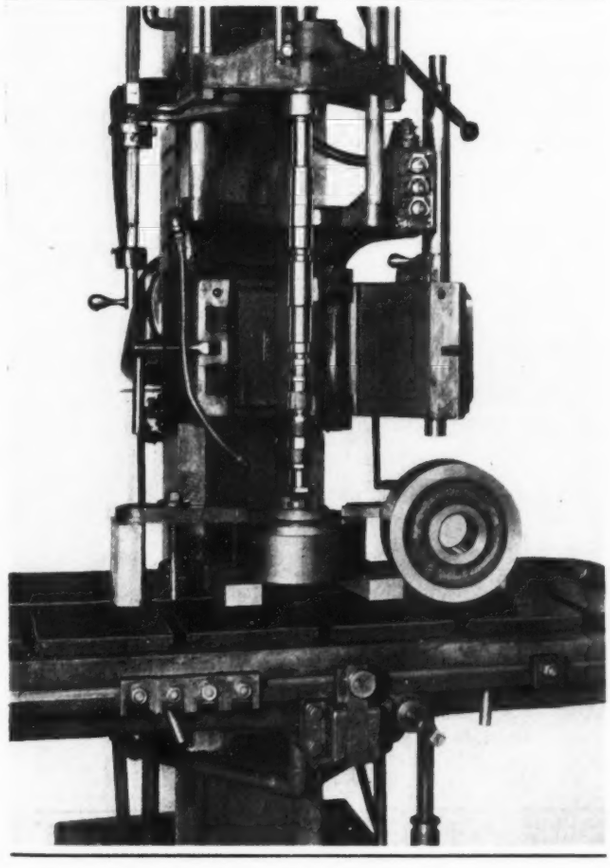
Builder Practices Preaches

Hydraulic cylinders with bores of 1 1/4, 2 1/8, and 3 1/2 inches in diameter are also honed in this plant for application to machine tools. Cylinders with a 1 1/4-inch bore are made in lengths up to 20 inches, cylinders with a 2 1/8-inch bore in lengths up to 56 inches, and cylinders with a 3 1/2-inch bore in lengths up to 36 inches. When a part is too long to be accommodated in a vertical type of honing machine, a horizontal honing machine is employed.

A table-arm casting for a round-column drilling machine is shown being honed in Fig. 1. The double bearing of this casting was honed to a diameter of 6 3/4 inches within an accuracy of 0.0005 inch.

The heading illustration at the right shows a machine engaged in honing the spindle sleeve bearing in one of the frame members for a self-oiling all-geared drilling machine. This bearing can be drilled and reamed in the same combination boring and honing machine, so that the hole can be completely machined in one set-up of the work.





Gear blanks of various types are honed with simple set-ups, such as shown in Fig. 2. The particular example here illustrated is a spiral gear, 9 inches in diameter by 3 1/2 inches face width. To insure concentricity of the gear teeth with the honed bore, the teeth are machined after the honing operation, with the gear blank located from the bore. A keyway is also cut after the honing operation has been completed.

Honing is especially advantageous for the finishing of machine tool parts, because it enables closer fitting of parts that must rotate or slide within each other. This close fitting of parts that have exceptionally smooth metal contact surfaces provides true alignment and tight bearings for long periods of time, greatly increasing durability and efficiency.

Fig. 2. Honing the Bore of a Spiral Gear before Cutting the Teeth and a Keyway. Simple Set-ups are Satisfactory for Operations of this Kind Due to the Fact that the Hone is Free to Follow the Bored Hole

Engineering News Flashes

The World Over

The Small Airplane Gains Ground

The prospects of a new aircraft industry in Manchester, England, have been substantially assisted by the success of a tiny 45-horsepower Praga monoplane which won the Isle of Man Aerial Derby. The plane competed against seventeen other planes over a 165-mile course. Some of the competing planes were capable of making nearly 200 miles an hour. The Praga plane is of Czechoslovakian design, the rights of manufacture for Great Britain having been acquired by F. Hills & Sons, Trafford Park, Manchester, England. A big demand for this small monoplane is expected, and the works are being tooled up for mass production.

A Giant Shop Truck

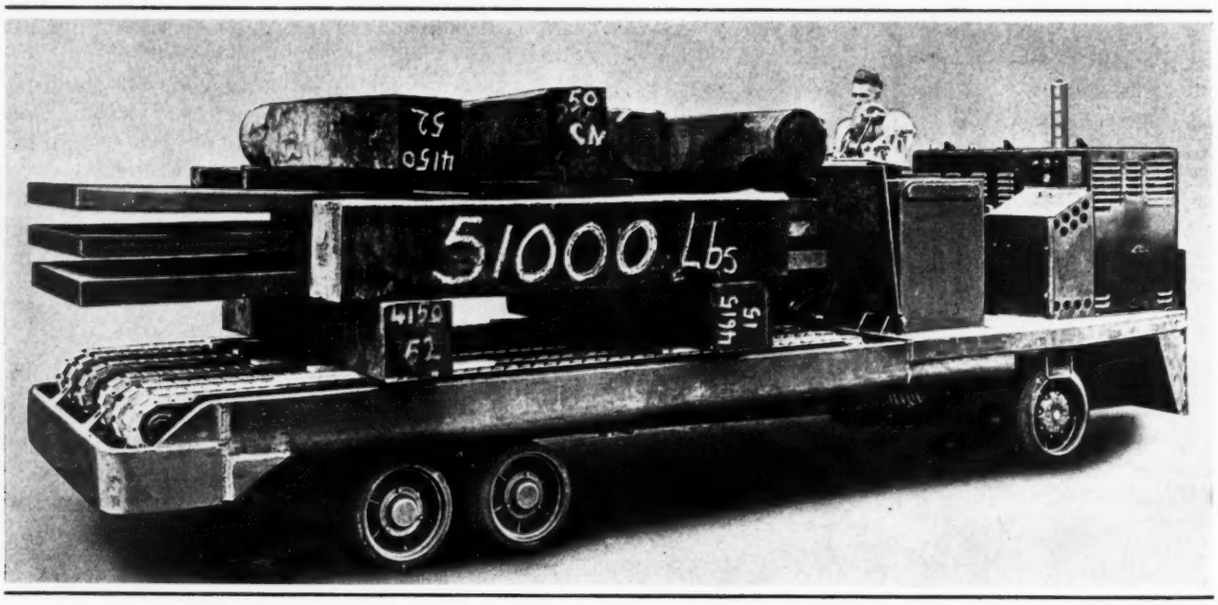
The accompanying illustration shows a gas-electric truck recently built by the Elwell-Parker Electric Co., Cleveland, Ohio, which has a normal load-carrying capacity of 40,000 pounds, but which, as indicated in the illustration, easily handled a test load of 51,000 pounds. Two of these trucks were recently delivered to a large steel company in the Chicago district. They are 21 feet in length and weigh 23,000 pounds. These trucks can travel 4 1/2 miles an hour under load. They are said to be the first trucks ever provided with chain-loading conveyors, and to be larger in over-all dimensions than any industrial truck ever before manufactured.

Automatic Lubrication of Conveyors

A device that automatically applies to every conveyor trolley wheel bearing, each time it passes a given point, the requisite amount of lubrication, and in the same manner lubricates every pin in the chain links, has recently been developed by the J. N. Fauver Co., Detroit, Mich. The self-contained lubrication assembly is mounted on the conveyor rail at any convenient point. Air pressure from an air line regulated by a valve forces oil drop by drop through a lubricator in the form of a fine mist to the bearings and pins. The volume of oil fed can be accurately controlled.

New Fuel for Buses and Trucks

Experiments in running motor buses by compressed coal gas are being carried out by the Wallasey Corporation, England. These experiments



A Huge Gas-electric Truck that Handled a 51,000-pound Load under Test

Erecting a Frequency-changer Set for the Consolidated Gas & Electric Co. in the East Pittsburgh Shops of the Westinghouse Electric & Mfg.Co. This Equipment is Rated at 30,000 K.V.A. and Converts Three-phase, 13,800-volt Current from 60 to 25 Cycles

are being watched with interest by transportation engineers throughout Great Britain. The gas is carried in two steel cylinders beneath the bus. According to *Industrial Britain*, the cost of the fuel per mile, as compared with gasoline, is not much more than one-half. If exhaustive tests prove satisfactory, as the tests conducted so far have been, a large number of buses will be converted for the use of coal gas.

A New Development in Weighing Scales

What is claimed to be a new principle in weighing has been incorporated in a scale known as the "Shadowgraph," recently developed by the Exact Weight Scale Co., Columbus, Ohio. It is stated that this scale eliminates the indicating tower mechanism and reduces the working parts by about 30 per cent, that it will function satisfactorily in a dust-laden atmosphere, that it is noiseless in use, and suitable to high-speed operation. It has found application in industrial plants where exact weight determination becomes part of the operation.

Another High-Speed Train Record

Now that the railways not only in this country but in Europe have entered upon what seems to be a new era of improved service, all kinds of records are being made in railway operation. The latest of these that has been called to our attention is the endurance record for steam trains which is claimed by the North Eastern Railway of England. The high-speed, specially built express train running between London and Newcastle early in July had covered 100,000 miles in a period of nine months. The average speed for these 100,000 miles has been slightly over 67 miles per hour, but 86,567 miles have been covered at an average speed of over 70 miles an hour, and 18,283 miles at speeds exceeding 80 miles an hour.

A Miniature Steel Plant for Development Work

A miniature steel works for developing the discoveries of its research engineers will be constructed by the Jones & Laughlin Steel Corporation. One of the first of its kind in the country, the midget plant will be equipped with actual steel-making units on a small scale, capable of duplicating the operations in regular mills. The construction of this miniature steel works marks a new approach to research in industry, bringing it into a position of greater and more practical importance than ever before.

In the past, it has been the general practice to turn over the discoveries of research engineers to the regular manufacturing departments for testing and development. Under this new system, Jones & Laughlin engineers will develop and test their ideas in the new "pilot plant," where they will have entire control of the miniature steel-making equipment, which will include an iron cupola, an open-hearth furnace, a Bessemer converter, a blooming mill, and various finishing devices.

In the "pilot plant," scientists will be able to start with the raw material, take it step by step through the blooming, rolling, shaping, and finishing operations, and turn out steel products of which they will have a complete and accurate history. The engineers can thus thoroughly test their ideas under a variety of operating conditions not possible in the regular manufacturing departments.

EDITORIAL COMMENT

In a series of "Short Talks on Advertising," prepared by the Bureau of Research and Education, Advertising Federation of America, we find the following paragraphs, which are well worth quoting:

"Despite fears of plaintive orators, men are still masters of their machines. There has been much careless talk lately by alarmists who picture mechanized production as a sort of Frankenstein monster bent on destroying its creator. Industrial efficiency is held up as a social evil. Misguided reformers talk of prohibiting any further development in machine manufacture. They would prefer a return to hand methods in order to employ more men to produce less. Machines, they say, have thrown men out of employment.

"As a matter of fact, we have our machines to thank for most of the material progress that our country has experienced in the past 150 years. However, no kind of progress comes without difficulties, and it is probably true that the introduction of machines has sometimes caused temporary dislocations. The real problem is to correct the dislocations rather than to scrap the machines and nullify progress.

Better Machines and Better Advertising Spell Progress

"Greater efficiency in one industry makes it possible to transfer some men and capital to other industries producing new products that will raise standards of living still higher. Demand for new products is quickly created by advertising. For the new industries to expand rapidly, extensive advertising is a vital necessity.

"It is important, of course, that wages and prices be in proper relation, in order that everyone may purchase his equitable share of the goods produced. It is equally important that every advance in production efficiency be accompanied by an expansion in actual demand for goods. This added demand does not come through wages alone, but through the realization of new desires on the part of consumers. This is the function of advertising."

On several occasions in the past we have referred to the importance of methods of taxation to American industry. Right methods of taxation will stimulate industry, and wrong methods will retard it. Taxes may be so excessive as to seriously hurt industry and reduce employment. On this subject, Charles R. Hook, president of the American Rolling Mill Co., recently made the following statement which deserves to be placed on record:

Wages are Reduced by Mounting Costs of Government

"The imposition of heavy tax burdens which increase the cost of useful products beyond the reach of the average man's pocketbook destroys the opportunity for employment. Such burdens will not long be tolerated in a democracy if the citizens really understand that it is against their own interests.

"With taxes today taking almost two days' pay out of the weekly wages of the average man, does it not seem reasonable that he should be the first to object to the ever-growing burden of taxation? Do industrial workers know that today local, state, and national taxes absorb from 25 to 30 per cent of the income of the people, and that, due to tremendous governmental expenditures, taxes are bound to be greatly increased? Do they know that the cost of all government in 1934 was $15,500,000,000, while the total income of all the people was only $48,000,000,000? Do they realize that their children will be burdened with a tremendous public debt? Do they know that the total 1934 automobile taxes, including license fees, gasoline and property taxes, totaled over $1,200,000,000, while the total amount of money received by the automobile manufacturers for the cars they sold to the dealers was only $1,147,000,000, which is just $53,000,000 less than the tax collected?

More Tax Dollars Mean Less Dollars for Necessities

Do people generally understand that the more of their income the Government takes in the form of taxes, the fewer automobiles, radios, and other pleasures and conveniences they can buy?"

These are not the words of an impractical faultfinder or a partisan politician running for office. They are the carefully thought out statement of an industrialist, who knows what it means to meet tax bills and payrolls alike—of a man who knows that the more dollars that have to go to the tax collector, the fewer are left for paying wages to labor and interest on the money used in the business. No public problem is of greater importance to all engaged in industry than that of excessive taxation.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Mechanism for Operating Two Slides Alternately

By J. E. FENNO

In one automatic wrapping machine, two parallel slides, operating alternately, control the movement of each package through the machine. Both slides, indicated at *A* and *B* in Fig. 1, are given the required reciprocating movement by the cross-head *C* through a combination ratchet and cam mechanism.

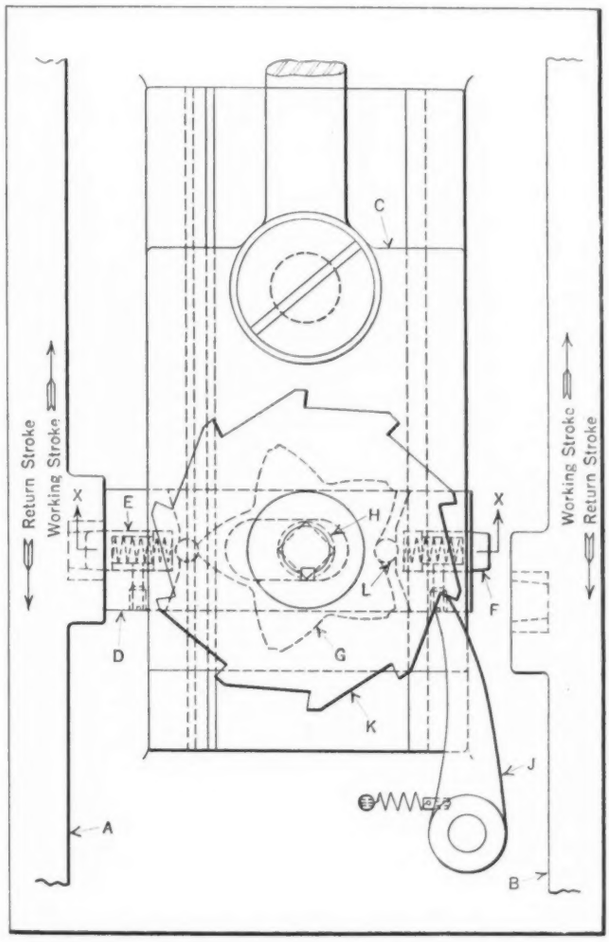


Fig. 1. Combination Ratchet and Cam Mechanism for Alternately Locking Two Parallel Slides to a Continuously Reciprocating Cross-head

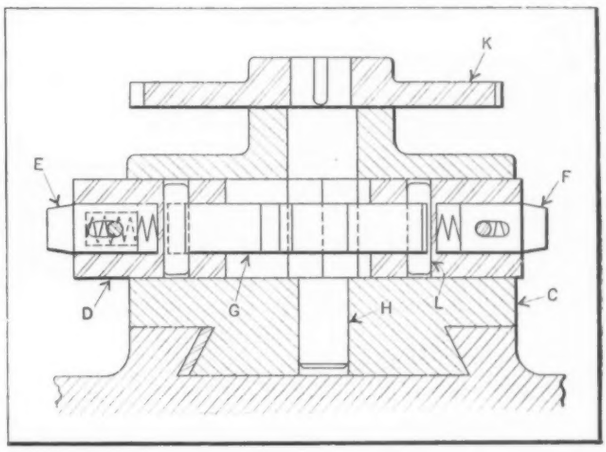


Fig. 2. Section X-X, Fig. 1, Showing the Action of the Locking Slide

The function of this mechanism is merely to lock the slides *A* and *B* alternately to the cross-head. The mechanism consists of locking slide *D* (see also Fig. 2); star cam *G* on shaft *H* engaging hardened pins *L* in the locking slide; ratchet wheel *K* keyed to the shaft and operated by the pawl *J* which is pivoted to the machine base; and locking plungers *E* and *F*, backed up by coil springs in the locking slide.

As indicated in Fig. 1, slide *B* is stationary and slide *A* is locked to the cross-head *C* by plunger *E*. Locked thus, slide *A* has completed a working stroke and has nearly reached the end of its return stroke. At this time, pawl *J* engages ratchet wheel *K*, and, as the slide *A* completes its return stroke, rotates the ratchet wheel and cam *G* one-tenth of a revolution. This results in the cam forcing slide *D* toward the right, unlocking slide *A* and cross-head *C*, and locking the latter to slide *B*.

With slide *A* now stationary, slide *B* and cross-head *C* are locked and travel together through a working and return stroke. Near the end of the return stroke, pawl *J* once more engages the ratchet wheel and causes the locking slide *D* to move this time toward the left. This movement of slide *D* unlocks slide *B* and cross-head *C* and locks the cross-head to slide *A*, which is then carried through a working and return stroke while slide *B* remains stationary.

To prevent over-run of the ratchet wheel, the ends of the cam lobes were slightly grooved to fit the hardened pins *L*. Both slides *A* and *B* operate at a relatively slow speed. It is advisable, however, when this mechanism is applied to rapidly moving slides, to provide some sort of a friction stop or brake, so that the slides will stop in the same position at the end of each return stroke.

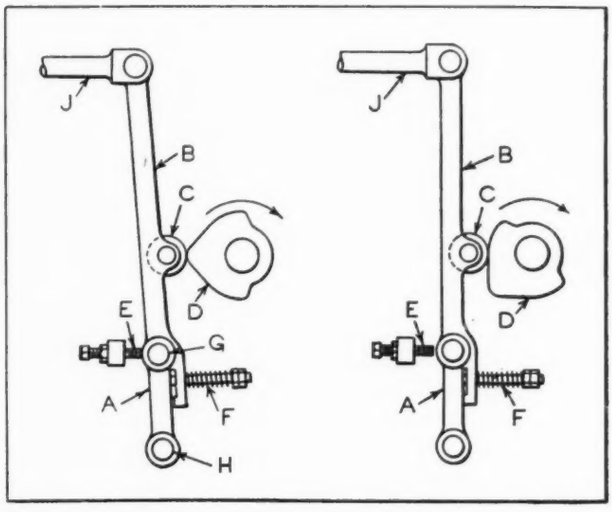
Adjustable Oscillating Mechanism for Reciprocating Movement

By L. KASPER

The length of stroke of a reciprocating member on a wire-forming machine required occasional adjustment to suit changes in the product. The reciprocating movement on this machine was obtained by the cam-operated oscillating lever shown at *B*, rod *J* being used to impart the required movement to the reciprocating member. The cam *D* rotates in the direction indicated by the arrow, the roller *C* on lever *B* being in contact with the cam surface.

Lever *B* fulcrums on stud *G*, which is located on the upper end of the short lever *A*, the latter, in turn, fulcruming on stud *H*. The lower end of lever *B* has an extension which is acted upon by the spring *F*. Normally, this spring serves to keep levers *A* and *B* in alignment. The stop-screw *E* in a lug on a stationary part of the machine limits the movement of lever *A*.

In the view to the right, the roller *C* is shown in contact with the middle portion of the lobe on cam *D*, the rise from the lower lobe of the cam being accomplished while levers *A* and *B* operate on stud *H* as a unit. As the upper lobe of cam *D* reaches roller *C*, continued movement causes screw *E* to make contact with lever *A*, preventing further movement of the latter lever, so that lever *B* then fulcrums on stud *G*, as indicated in the view to the left. The change in the ratio of leverage increases the movement of rod *J*, as controlled by the setting of stop-screw *E*. Roller *C* is held in contact with cam *D* by a spring which acts against the working end of rod *J*.



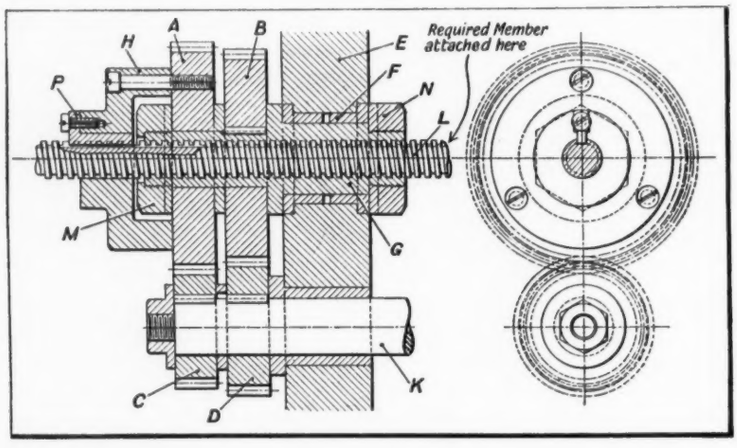
Cam-operated Oscillating Lever with Stroke Adjustment, Used to Obtain Reciprocating Movement

Mechanism for Producing Rotating and Traversing Movement

A simple mechanism designed to impart a combination traversing and rotating movement to a machine member is shown in the accompanying illustration. Two gears *C* and *D* are keyed to the driving spindle *K* and retained by a flanged nut. The driving shaft *L*, which serves to rotate and traverse the machine member as required, has a screw thread and a keyway which is a sliding fit for the key *P*. The sleeve *G* is arranged to run freely in the bushings *F*, housed in the web *E* of the machine. End thrust imparted to this sleeve is taken by the large flange and the flanged nut *N*. Sleeve *G* is threaded on the inside to suit shaft *L*.

The gear *B* is keyed to the sleeve and the gear *A* runs freely on it, both gears being retained by the flanged nut *M*. The part *H* is secured to gear *A* by three screws. Key *P* is held to part *H*, as shown, and slides in the keyway in shaft *L*.

To make clear the operation of the mechanism, let it be assumed that gears *A* and *C* have forty-eight and twenty-four teeth, and gears *B* and *D*, forty-seven and twenty-five teeth, respectively. Let the member to be actuated, and consequently shaft *L* and gear *A*, make one revolution. Then gear *C* and shaft *K* will make $48 \div 24 = 2$ revolutions.



Mechanism for Imparting a Rotating and Traversing Movement to Shaft L from the Driving Spindle K

When gear D makes two revolutions, gear B makes $\frac{25}{47} \times 2 = \frac{50}{47}$ revolutions.

Thus shaft L rotates relative to sleeve G, and a traverse feed movement is imparted to the member. If the screw thread on shaft L has 10 threads per inch, the distance through which shaft L is fed during one revolution equals $\left(\frac{50}{47} - 1\right) \times \frac{1}{10}$ = 0.0064 inch.

Different feeds and speeds can be obtained by varying the ratios of A to C and B to D.

G. L. W.

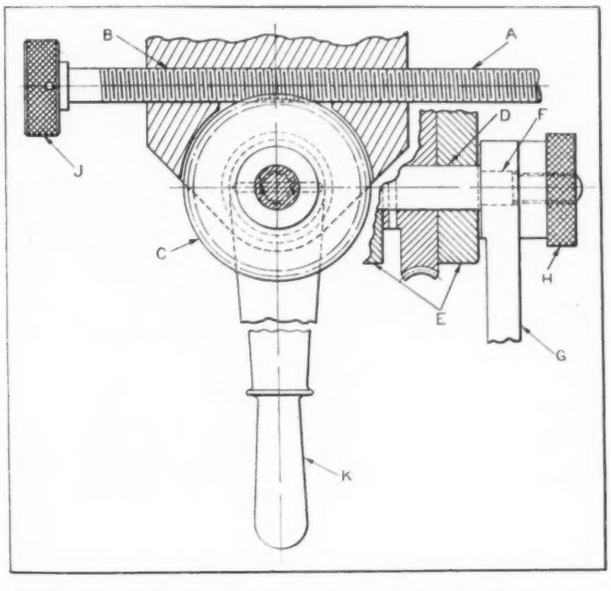
Mechanism for Obtaining Coarse and Fine Feeding Movements

By JOHN A. HONEGGER

Recently the writer had occasion to build a small milling machine type of grinder for cutting slots 1/16 inch wide by 1/8 inch deep in some square, hardened pieces. The screw and worm-wheel mechanism shown in the accompanying illustration was developed for the purpose of obtaining a quick approach to the grinding wheel and a fine feed for grinding the slot. A rubber cutting wheel was used for the slot-grinding operation.

The screw or worm A is a close sliding fit in the bore B and engages the worm-wheel C as shown. The worm-wheel is pinned to the stud D which has a bearing in the cast-iron bracket E. The stud D is made square at F to accommodate the lever G, and is threaded to receive the knurled nut H.

In operation, the handle K of lever G is moved in either direction. This causes the screw A to slide in or out with much the same action as a rack operated by a pinion. After using the lever to bring the work into the grinding position, the knurled nut H is tightened to hold the lever stationary. A fine feeding movement can then be obtained by turning the knurled nut J, worm-wheel C acting as a fixed nut for the screw A.



Mechanism in which Worm-wheel C Acts as a Pinion and Worm A Serves as a Rack

* * *

Maintaining Quality in Used Machinery Exports

The Machinery Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C., emphasizes that the selling of used American equipment abroad carries with it the same responsibility for the reputation enjoyed throughout the world by American machinery as the export of new equipment. A number of export markets are now suitable for the disposal of used American machinery. Reconditioned equipment is likely to attract prospective foreign buyers in many countries.

It is in the interest of the American machine-building industry as a whole to do all that is possible to see that all used and rebuilt equipment going abroad is in such condition that the reputation for quality of product and integrity of American manufacturers is maintained. "The delivery of one machine in poor condition," says the Bureau of Foreign and Domestic Commerce, "will destroy the good reputation for American equipment built up by the export of ten high-grade machines."

* * *

Demonstration of the Grinding of Cemented-Carbide Tools

At the National Metal Exposition, held in Cleveland during the latter part of October, the Carboloy Co., Inc., Detroit, Mich., manufacturer of Carboloy tools, dies, and wheel-dressers, featured the latest technique in grinding cemented-carbide tools. This demonstration proved of great interest to production executives because of the unusual economies made possible by correct carbide-tool grinding. In this demonstration, the new 6- and 10-inch Carboloy tool grinders were used. Another feature of the Carboloy exhibit was the display of improved equipment for servicing Carboloy drawing and extrusion dies.

* * *

Color Code for Marking Steel Bars

The Division of Simplified Practice of the National Bureau of Standards, Washington, D. C., is proposing a simplified practice recommendation for a color code for marking steel bars. Copies of the proposal have been sent to interested companies for approval. Copies may be obtained free of charge from the Bureau of Standards.

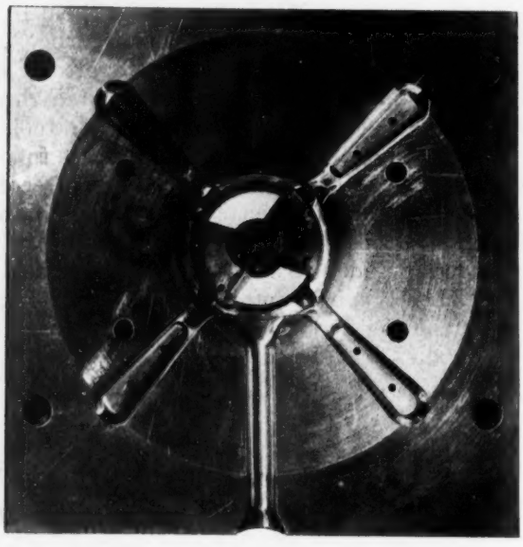
Cam Slots Formed in Die-Casting by Loose Die Parts

A Description of the Dies that Produce Spider Handles for Electric Washing Machines

By CHARLES O. HERB

THE unusual feature of the set of die-casting dies illustrated in Fig. 1 is that they are designed with loose die parts that are ejected with the work after each operation. These dies were made by the Madison-Kipp Corporation, Madison, Wis., for producing the zinc washing-machine spider handle shown in the heading illustration. The loose parts are required to produce irregular cam slots in opposite sides of the handle hub to the outline indicated at *Y* in Fig. 2. These cam slots are formed to a depth of 1/8 inch and are "blind" —that is, they do not extend through the hub metal. Three loose pieces *A*, *B*, and *C* are required to form each cam slot. These pieces are slipped over pins mounted on plate *D* when the latter is out of the die. This plate, with pieces *A*, *B*, and *C* in place, is slipped over core *E* of the stationary die when the movable die is in the withdrawn position. The movable die is then closed against the stationary die for the casting operation.

When the movable die is again withdrawn from the stationary member as the operation is com-



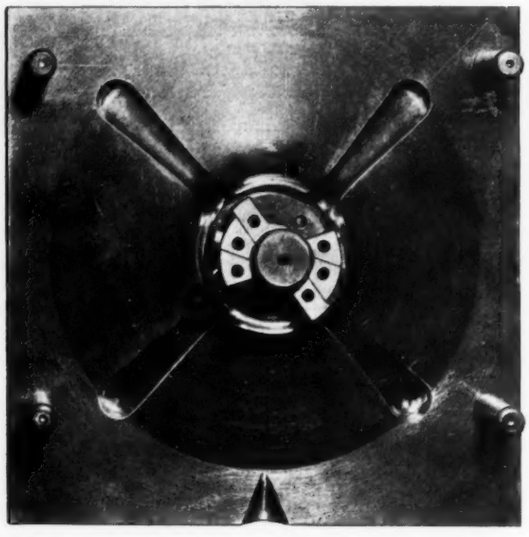


Fig. 1. Die-casting Dies Made with Seven Loose Pieces to Permit the Forming of Irregular Cam Slots in Spider Handles

pleted, plate *D* and the six loose pieces that form the cam slots are pulled off core *E* by the die-casting. The casting, with the slot-forming parts, is ejected from the movable die by pins attached to plate *F* as the movable die approaches the end of its opening stroke.

Plate *D* is then withdrawn by hand from the casting to facilitate the removal of pieces *A*, *B*, and *C*. Piece *C* of each set is withdrawn from the casting first, then piece *B*, and finally piece *A*. Several sets of these loose pieces and holding plates are kept on hand, so that time can be saved by assembling and disassembling them while another operation is in process.

Pin *H* locates plate *D* radially on the stationary die, so that the loose pieces will register properly with the slotted block *J* when the dies are closed. As the movable die approaches the stationary die, four pins *K* return plate *F* and the ejector-pins to the positions shown.

The spider handle formed in these dies is approximately 11 1/2 inches in diameter across the ends of the spokes. A generous gate was provided to carry the required amount of molten zinc to the die cavity. At the point where the metal actually enters the cavity, the gate is about 3 inches wide by 0.035 inch deep. These dies are used on an automatic die-casting machine. About two shots can be made a minute.

Exposition Indicates Advance in Die-Casting

The exhibits of die-castings and die-casting machines at the National Metal Show, held during the past month in Cleveland, Ohio, indicate that a remarkable advance has been made in die-casting procedure. Recently several die-casting machines have been perfected that are faster and more automatic than any equipment used for this purpose in the past, making possible the economic production of an ever increasing number of die-cast parts, especially in the smaller sizes.

An excellent example of what is being done in this direction is the casting of a part for a surgical instrument which has a total weight of 0.14 ounce avoirdupois, and a wall thickness of only 0.023 inch. This tiny casting formed an interesting contrast at the exposition to the automobile radiator grilles which are die-cast in one piece with dimensions running up to 34 by 17 inches and with a depth of 6 1/2 inches. These and a large number of other die-castings, together with complete assemblies of electrical appliances, business machines, household equipment, etc., in which zinc alloy die-castings are being utilized, were on exhibition in the booth of the New Jersey Zinc Co. The various production steps in turning out zinc alloy die-castings were shown by a series of photographs.

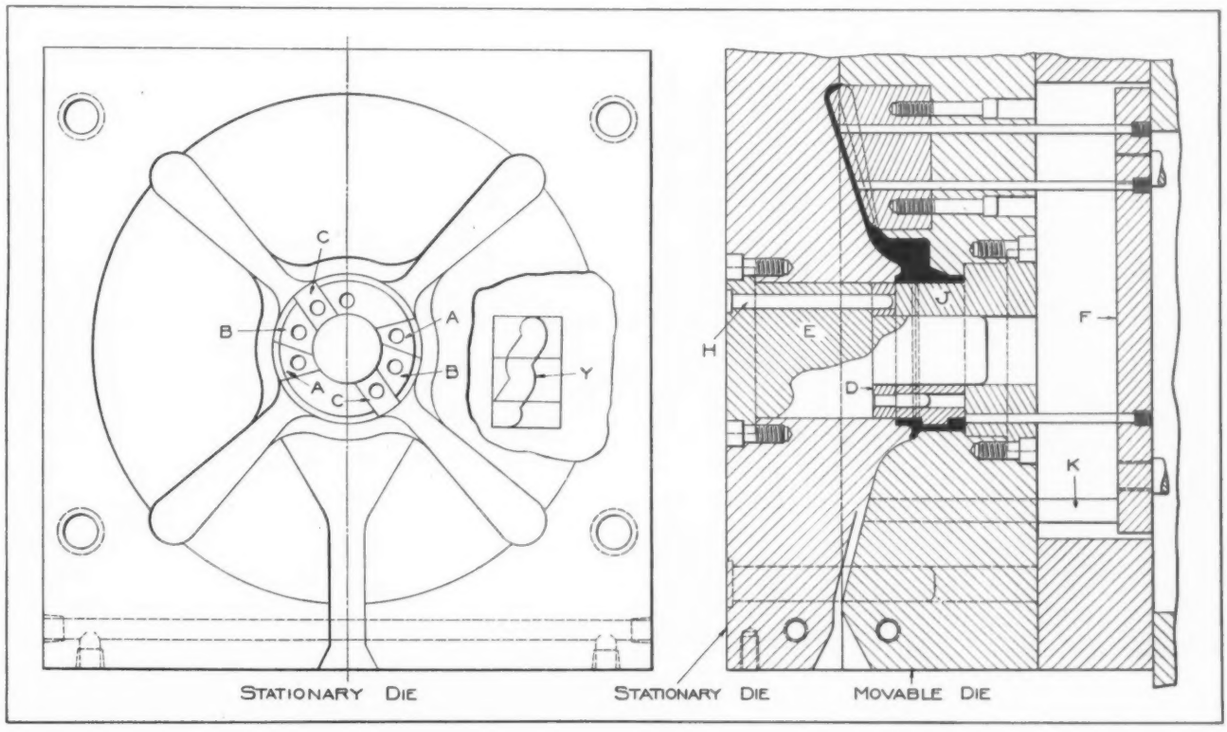


Fig. 2. Loose Pieces in this Die-casting Die Form Two Cam Slots of the Outline Indicated at Y in the Spider Handle Shown in the Heading Illustration

Trepanning High-Speed Steel Sheets

By F. D. MONDIN
Time Study—Tool Department
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

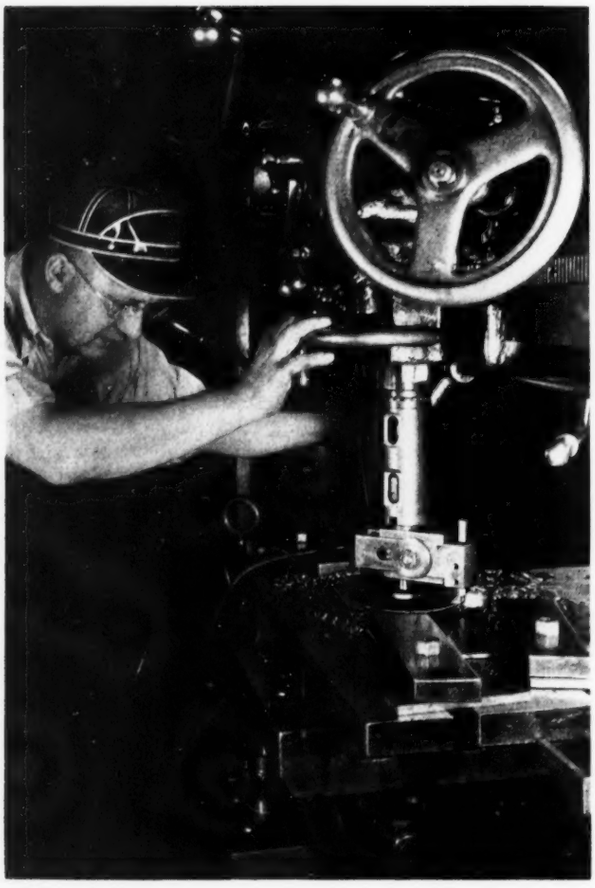


Fig. 1. Cutting Disk from High-speed Steel Sheet with a Trepanning Tool

NUMEROUS methods, such as fly-cutting, punching, and nibbling are employed by tool manufacturers for cutting disks from steel sheets. However, when an attempt is made to use these methods in cutting high-speed steel containing about 18 per cent tungsten, 4 per cent chromium, and 1 per cent vanadium, difficulties are encountered. A trepanning tool such as shown in Fig. 1 meets the requirements of this class of work. This tool provides an unusual opportunity for reducing tool costs, as it enables the high-speed steel disks required in the manufacture of saws, cutters, spacer washers, etc., to be cut from sheet stock instead of having to purchase the material in the form of forgings or blanks, for which extra charges are made.

The trepanning tool shown is being used successfully on a radial drilling machine for cutting out disks 2 3/4 to 10 inches in diameter from high-speed steel sheets 0.143 to 0.312 inch thick by 16 1/2 inches wide by 72 inches long. The locations of the disks on the sheet stock are laid out as shown by the dot-and-dash circles *A* in the upper view of Fig. 2. In laying out the work, 1/32 inch of material is allowed between the holes cut out by the tool, in order to avoid an intermittent cut which might cause tool breakage. Holes of the size required for the tool arbors in the disks are then drilled in the flat stock, allowance being made for grinding the holes after the disks are hardened. The sheet stock is next located on the plate and the draw-pin *B*, Fig. 2, is placed through one of the drilled holes and located in the hardened bushing *C*. The drift key *D* is now inserted in the slot in rail *E* and passed on through the slot in the draw-pin. The draw-pin is then tapped to tighten the center of the sheet firmly on the supporting base. The upper end of pin *B* acts as a bearing for the tool-holder *G*.

The draw-pins are made of an alloy steel, carburized to a case depth of 1/16 inch and finish-ground all over. Several pins *B* may be made to suit holes of different sizes, as required. The tapered shank of the trepanning tool is secured in the drilling machine spindle by a tapered key. The lowering of the spindle brings the trepanning tool over the end of the draw-pin. The tool is then set to cut a disk of the correct diameter, as previously laid out on the sheet. The tool adjustment is made through the tool-holder slide *H*. After the tool-slide has been set, it is firmly locked in place by tightening the clamping nut *J*. When the slide is in the position shown, it can be adjusted to cut disks from 2 3/4 to 6 1/2 inches in diameter; when located on the opposite side of the holder, it can be used to cut disks ranging from 6 1/2 to 10 inches in diameter.

Fig. 2 shows a plan and side view of the trepanning tool and fixture in position on the machine table *F*. The clamping of the sheet has been simplified, so that the operator merely moves the four clamps *K* to any convenient positions which will clear the tool-holder. The slots in the base are so positioned that the sheet may be located from either side of the table. Considerable time is saved by this method of clamping. The time required for locating a sheet in position and removing the cut out disk complete after trepanning amounts to only 3 1/2 minutes.

The design of the trepanning tool, on which the success of the trepanning operation largely depends,

is shown in Fig. 3. This tool is made of cobalt high-speed steel and hardened to 85-90 scleroscope. For best results, it is essential that the cutting edge be formed by grinding the various surfaces to the angles shown. This reduces the number of regrinds required, prevents chattering, and extends the life of the cutting edge. The back clearance, ground on a radius of 1 5/16 inches, prevents the cutting edge from being destroyed by abrasive wear when cutting disks from 2 3/4 inches in diameter up.

Obviously, a cutting tool that extends out an excessive amount from the point of support cannot withstand as high a speed and feed as a tool supported by a square tool-block. Using the radial drilling machine for trepanning with the tool and fixture described, a cutting speed of 53 feet per minute was attained in producing disks 10 inches in diameter. The average speed for cutting disks ranging from 2 3/4 to 10 inches in diameter was 43 feet per minute. On an order for twenty-four disks, 2 3/4 inches in diameter, the lay-out, drilling, and trepanning from a sheet of high-speed steel 0.143 inch in thickness was completed in 3 hours and 18 minutes. Assuming that the same order were to be filled from bar stock, the time required for turning, drilling, dressing, and cutting off would be 4 hours and 48 minutes. Thus, there was a saving of 28.8 per cent in time by using the trepanning method. The saving in time increases with the increase in diameter, being as high as 70 per cent over the forging method in some cases.

Additional savings in reductions of time for ma-

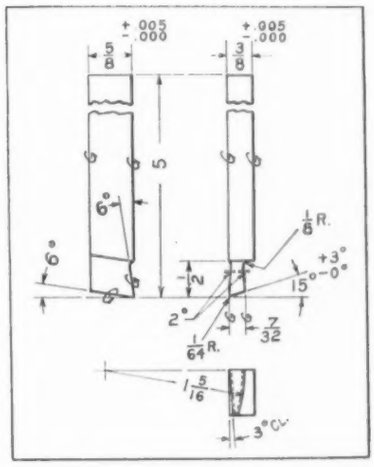
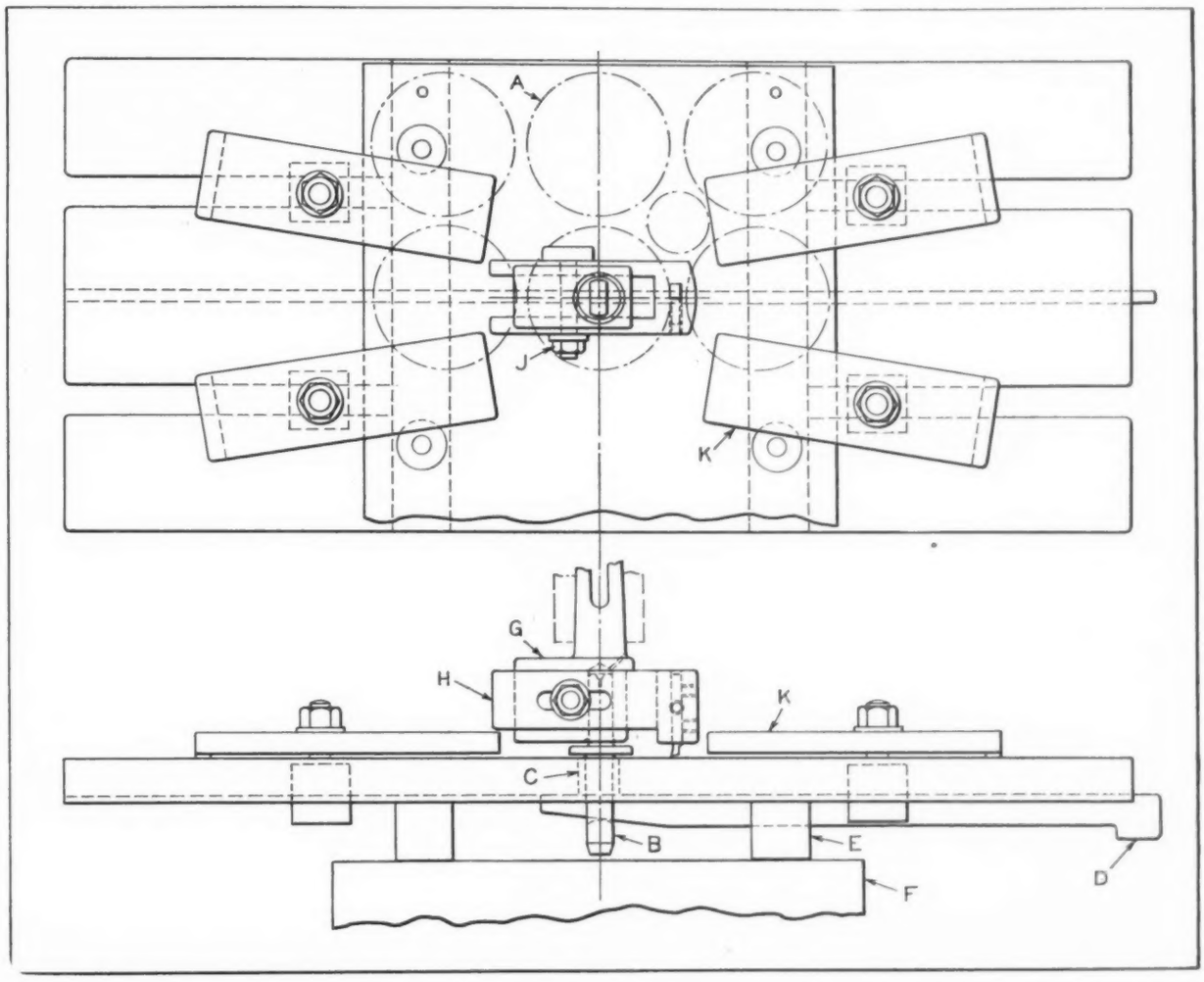


Fig. 3. Design of Trepanning Tool Used in Cutting Disks from High-speed Steel

Fig. 2. Plan and Front Views of a Set-up Similar to the One Illustrated in Fig. 1



terial-handling can be realized when a sheet 16 1/2 by 72 inches can be used to fill an order for disks of various diameters, necessitating the handling of the sheet but once. It also eliminates the necessity for carrying quantities of bar stock or disks of various sizes. The steel sheets may be stocked according to production requirements, one thickness taking in several sizes. For example, sheets ranging from 0.143 to 0.312 inch in thickness may be used for any size disk of these thicknesses. An additional 14.2 per cent saving in material is also gained by selling the scrap sheet from which the disks have been cut.

A summary of the complete analysis of the results obtained by the trepanning method showed a saving of 28.8 per cent on disks 2 3/4 inches in diameter over the machining method, with substantial increases on larger sizes. The saving was 70 per cent over forged blanks and 30 per cent over steel disks furnished by the dealer.

* * *

Contests for Apprentices in Molding and Patternmaking

The American Foundrymen's Association has announced that a molding and patternmaking contest, similar to that which met with such success at the 1936 convention, will be held in connection with the 1937 meeting. Prizes of $40, $25, and $15 will be awarded in three classes of entries comprising steel molding, iron molding, and patternmaking. If sufficient interest is evidenced in the non-ferrous field, this group will also be included in the competition. Local contests will be held under the supervision of individual foundries or foundry groups. Copies of the complete regulations may be secured by writing the American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

Effect of Press Fits and Surface Rolling on Strength of Shafts

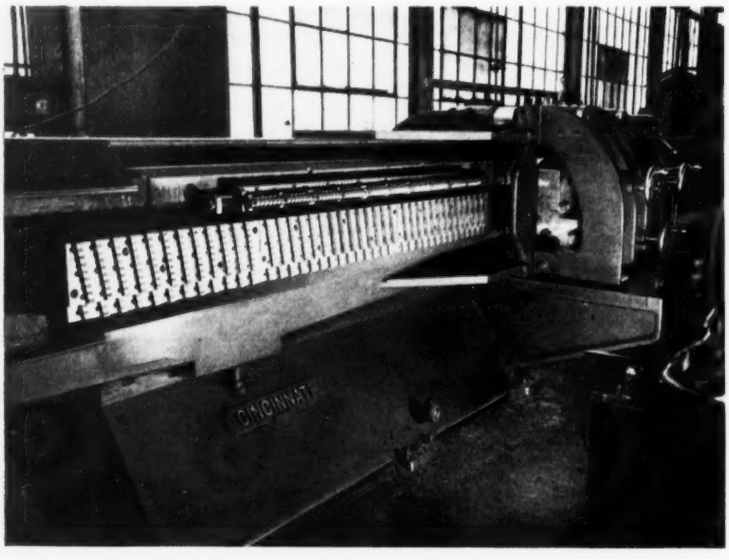
In a paper presented before the annual meeting of the American Society for Metals at Cleveland, Ohio, T. V. Buckwalter, vice-president, and Dr. O. J. Horger, research engineer, of the Timken Roller Bearing Co., Canton, Ohio, summarized a series of recent investigations made by the company as follows: (1) A press fit reduces the fatigue strength of an axle to less than half the strength of a similar axle not assembled by a press fit. (2) Surface rolling of the axle at the sections that are subjected to a press fit practically restores the full strength of the axle, making it possible to obtain in press-fitted assemblies practically the same strength as is available in plain axles that are not subjected to press fits.

To determine the effect of surface rolling on large axles and to secure further data relating to forging and heat-treating practice on large sections, the Timken Roller Bearing Co. is building a fatigue testing machine having a capacity for testing axles up to 13 1/2 inches in diameter.

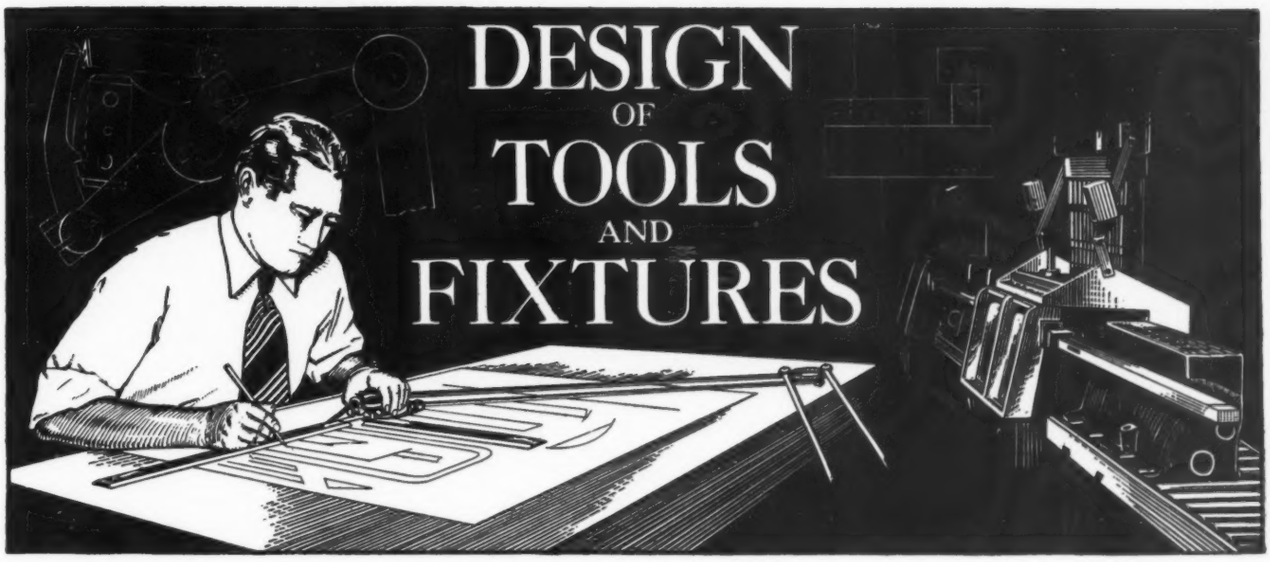
* * *

Machine Tool Dealers Elect Officers

The Associated Machine Tool Dealers held their annual meeting at Granville, Ohio, September 21 and 22, at which the following officers were elected: President, Harry Barney, Barney Machinery Co., Pittsburgh, Pa.; vice-president, A. G. Bryant, Bryant Machinery & Engineering Co., Chicago, Ill.; secretary-treasurer, John Sauer, Jr., Peninsular Machinery Co., Detroit, Mich. The directors elected are A. S. Bush, Charles A. Strelinger Co., Detroit, Mich., and E. R. Motch, Jr., Motch & Merryweather Machinery Co., Cleveland, Ohio.



Using round and slab broaches for machining in one pass the exhaust port bosses, the valve spring cover face, the fuel pump pad face and the oil manifold face of Nash cylinder blocks at an operating speed of 25 feet per minute with broaches made by the National Broach & Machine Co. from special Na-Loy steel. Average production, 38 blocks an hour. Tolerance, 0.003 inch. Number of hard cast-iron blocks per grind, 3000; number of blocks machined per set of tools, 20,000



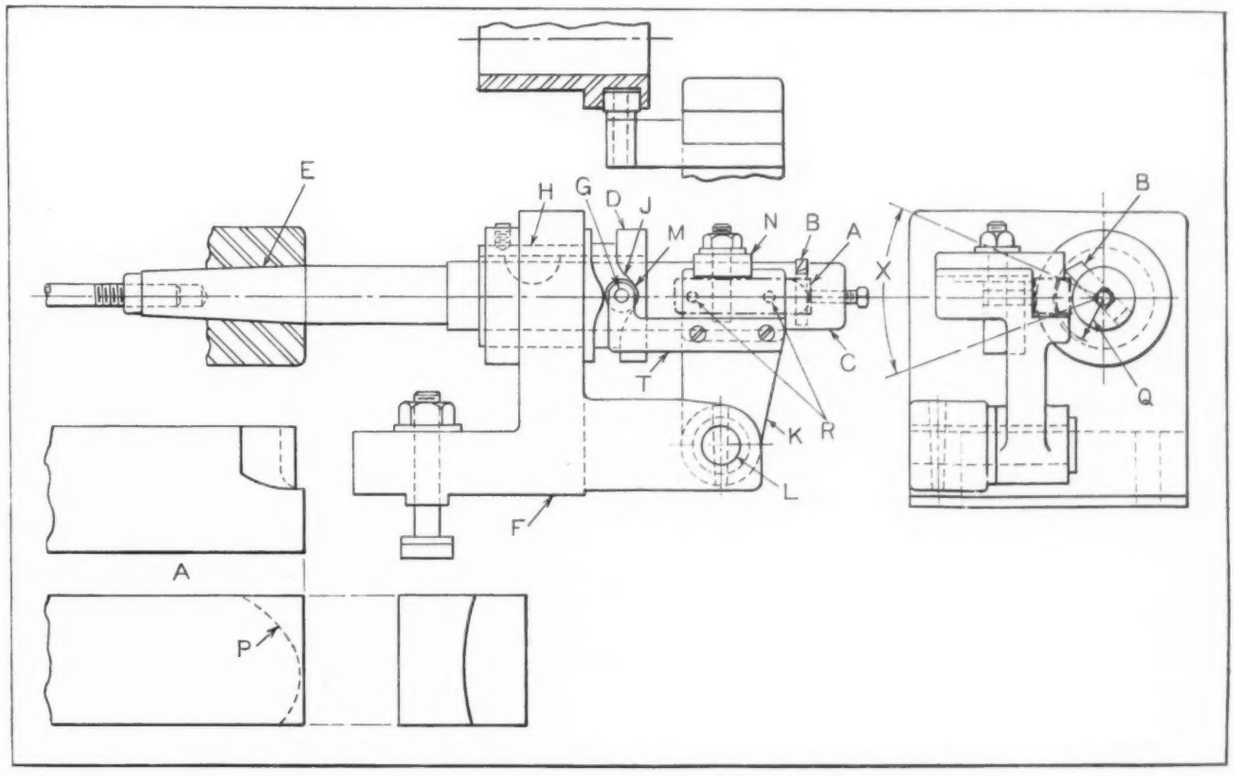
Fixture for Milling Cam Surface on End of Bar

By FRANK HARTLEY

The cutting of a cam surface of unusual design on the end of a steel bar used in a certain machine was accomplished in the milling fixture shown in the accompanying illustration. The work *A* is shown by the enlarged views in the lower left-hand corner of the illustration. The profile of the cam surface is indicated by the dotted line *P*.

The revolving cutter *B*, secured in bar *C*, takes the radial end cut required to form the cam surface. The rocking action of the work-holding member *K* is obtained through the drum cam *D*. This cam has its outline or curve formed to compensate for the rocking movement, so that the cam surface on bar *A* will function properly in the machine for which it is intended.

Bar *C* is held in the spindle of the milling machine by the tapered shank *E* and a drawback rod which passes through the milling machine spindle. The fixture base *F* is attached to the milling ma-



Fixture Designed for Milling Cam Profile Indicated at P

chine table with clamping screws. The boring-bar passes through a sleeve *H* to which it is slidably keyed. The drum cam *D* is machined on sleeve *H*. The cam surface at *J* engages a roll *M*, retained by stud *G* on bar *T*. It will be seen that this construction causes the work-holding member *K* to pivot on the stud *L* in such a manner that the revolving cutter *B* machines the cam end of bar *A* to the required shape.

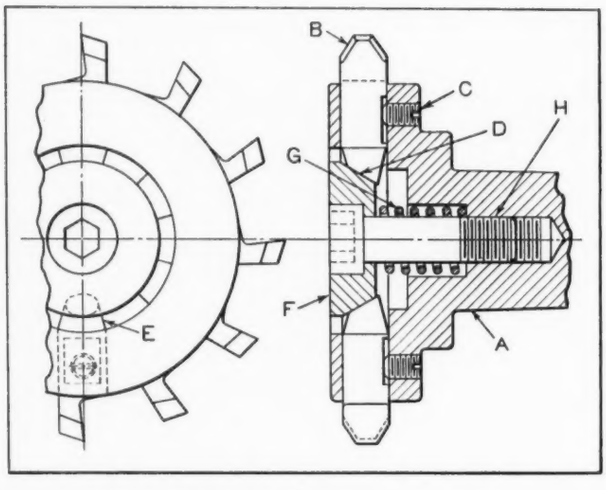
The work is located lengthwise on the swinging holder *K* by two short pins *R*, and is held in place by the clamp *N*. The fixture is mounted on the table of the milling machine and is fed crosswise, so that any amount of material can be removed from the end of bar *A* by the revolving cutter which cuts to the radius *Q*.

Milling Cutter with Interchangeable Blades of Special Shapes

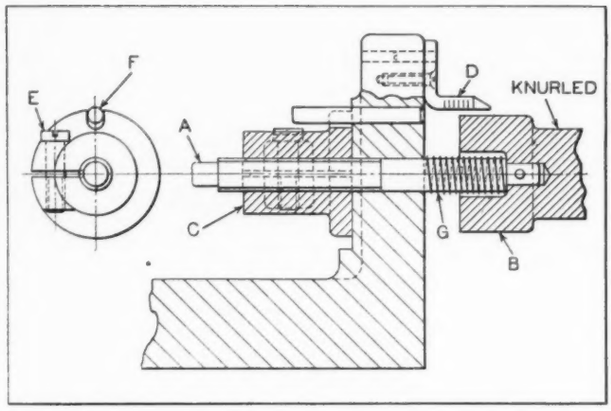
By JOHN A. HONEGGER, Bloomfield, N. J.

A milling cutter in which interchangeable bits or blades of different shapes can be inserted for small-lot jobs is shown in the accompanying illustration. It consists of the stub arbor and cutter housing *A* having the desired number of reamed holes for bits *B*. The bits may be made from drill rod or other round stock. They are ground on the sides and ends to the special shape required. A flat is milled on one side of each bit to form seats for the set-screws *C*. The opposite ends of the bits are ground to the required angle at *D*, after which they are chamfered at *E*.

The bits are inserted in the housing until they rest against the adjustable stop *F*, after which they are clamped in place by means of the set-screws *C*. Stop *F* is normally held in the outward position by the spring *G*. Adjustment of the stop is obtained by the screw *H*. When specially shaped contours are to be milled, a set of bits can be ground to the required shape. The bits can be inserted and taken out as desired without removing housing *A* from the milling machine.



Milling Cutter with Interchangeable Blades



Micrometer Stop for Locating Shaft in Gear while Drilling Hole for Fastening Pin

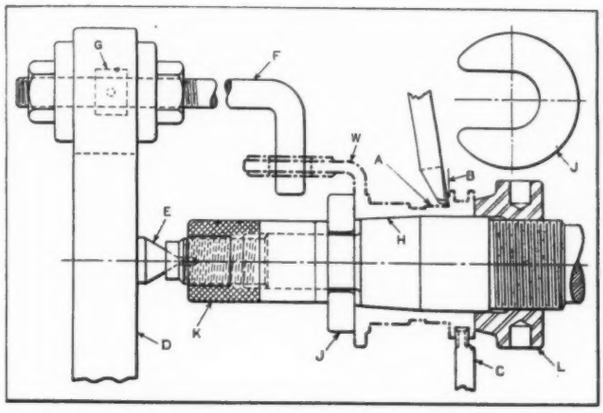
Work-Locating Stop with Micrometer Adjustment

By PHIL E. VERAA, Richmond Hill, L. I.

A stop with a micrometer adjustment for locating the end of a shaft inserted in a gear to permit drilling a hole through the two assembled parts is shown in the accompanying illustration. The stop is so designed that it can be pushed forward to facilitate removing the shaft from the gear after the hole has been drilled. Accurate adjustment of the stop is necessary, as its position must be changed frequently to suit different shafts and gears.

The stop is provided with a collar *B* having graduations corresponding to adjustments of 0.001 inch. The stop-screw *A* has twenty threads per inch, and the collar *B* has fifty graduations on its circumference. Collar *B* is pinned to the stop-screw. In assembling the parts of the stop, the stop-screw is screwed into the bushing *C* for a predetermined length, and the collar *B* set at the zero line on the pointer *D*. With the parts thus assembled, a hole is drilled through the knurled collar and the stop-pin. These parts are then pinned together. The pointer *D* is graduated with lines 0.050 inch apart, which corresponds to one turn of the collar *B*. This permits quick reading of the stop adjustment and eliminates the necessity for measuring.

The bushing *C* is made of phosphor-bronze and is slotted on one side. A clamping screw *E* is provided for adjusting the thread fit. The steel stop-screw is cyanide-hardened at the contact point. The stop-screw is pushed forward to facilitate the removal of the drilled shaft from the gear, guide pin *F* serving to prevent bushing *C* from turning. The coil spring *G* returns the stop to its original position.



Arbor and Work-driving Unit for Turning, Facing, and Grooving Operations on Part W

Arbor for Grooving and Turning Operations

By F. SERVER

The lathe arbor and the driving unit on the faceplate shown in the accompanying illustration solved the problem of locating and driving the work *W* while turning the surface *A*, facing shoulder *B*, and cutting a groove with the tool *C*. The arbor is mounted between centers in the usual manner, the faceplate being shown at *D* with the live center at *E*. The rod *F*, clamped to the faceplate, has one end bent down, so that it enters a hole in a projection on the work and acts as a driver. Clamping nuts and collars on opposite sides of the faceplate serve to hold the rod *F* in place. A square bushing *G* which fits the slot in the faceplate is pinned to the rod to prevent it from turning in the slot while under the driving strain.

The work *W* is forced over the arbor until it binds on the tapered portion *H*. It is then clamped by means of a C-shaped collar *J* and knurled nut *K*, which has a left-hand thread. Flats milled on the sides of nut *K* permit a wrench to be used for releasing the nut, should it become too tight to be removed by hand. The nut *K* is turned as tight as possible by hand, so that the work will register accurately on the taper, the hole being reamed within very close limits. Accurate positioning of the work is necessary to insure machining the shoulder and the groove to close limits, stops being used to locate the tools and control the length and depth of the cuts. A threaded collar *L*, brought up to the work by hand, assists in holding the work in place. The collar *L* is also used to force the work off taper *H* after nut *K* has been loosened slightly and collar *J* has been removed.

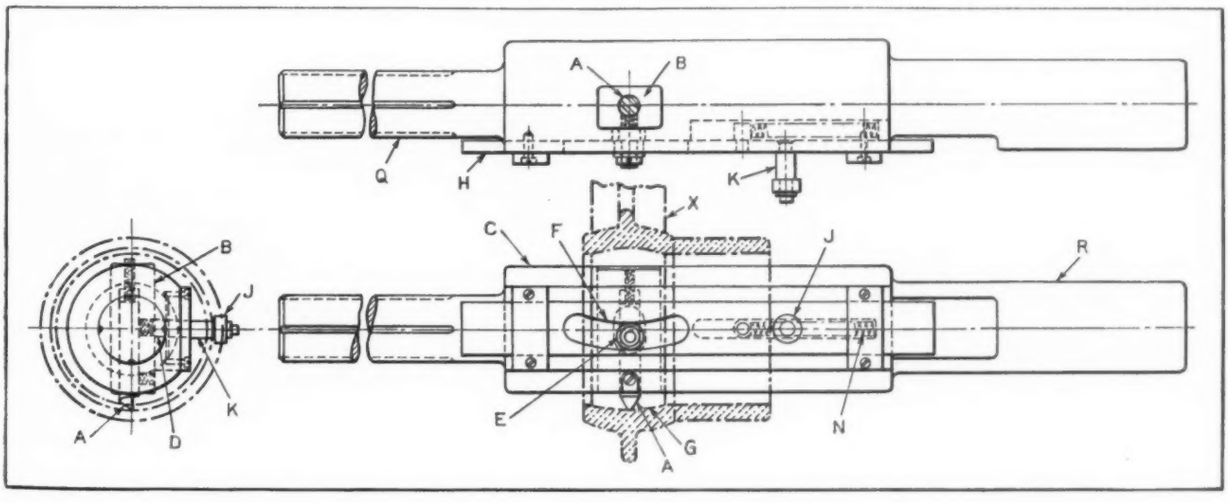
Boring-Bar for Machining Oval Recess

By FRANK SERRAL

The special boring-bar shown in the accompanying illustration is equipped for boring the spherical or oval recess at *G* in the work *X*. The cutter *A* is of the pin type and is clamped in the holder *B*, which is a sliding fit in a crosswise slot in the boring-bar *C*. The curved slot at *F* in bar *H* controls the crosswise movement of holder *B*, which causes the cutter point to follow the curved path necessary for boring the oval recess *G*.

Mounted in holder *B* is a stud *D* which carries a roll *E*. This roll is in contact with the curved surface of the slot *F* in bar *H*. As the boring-bar is passed through the work, the roll *J*, mounted on stud *K* in bar *H*, comes in contact with the end of work *X*, causing bar *H* to remain stationary. Bar *H* is free to slide lengthwise of the boring-bar *C* in a groove cut the full length of the latter member. As bar *C* continues to advance, the slot *F* transmits a crosswise movement to holder *B* through contact with roll *E*, which results in boring the oval recess *G*.

When the boring-bar is returned to its starting point after completing the cut, the compression



Boring-bar Used in Turret Lathe for Machining Oval Recess at G

spring *N* causes slide *H* to return to its starting point at the left end of the boring-bar. The outer end of the boring-bar is supported by a pilot *Q* which enters a bushing in the machine spindle. The end *R* of the boring-bar is held in the turret of the machine.

Die for Extruding Soft Metal Caps

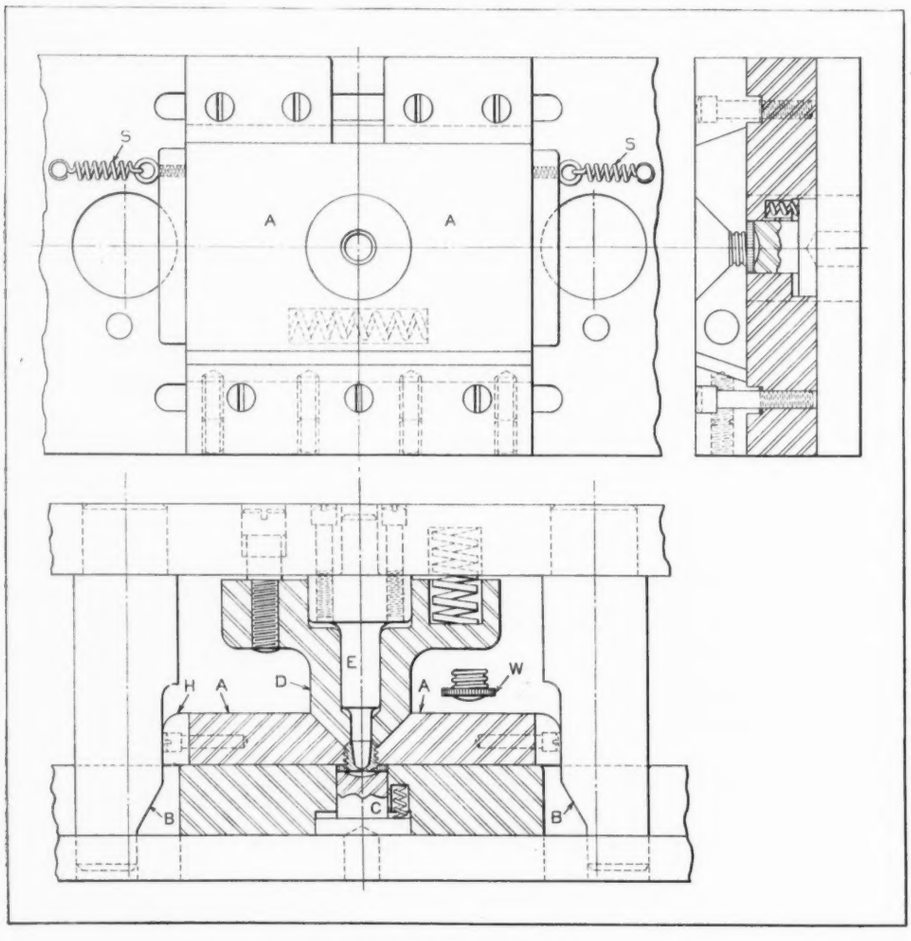
By WILLIAM C. BETZ, Equipment Engineer
Fafnir Bearing Co., New Britain, Conn.

Although container caps of synthetic plastic materials have replaced to a great extent those made of metal, there is still a demand for metal caps, especially for use on containers for certain chemical products and in cases where greater strength is required. The cap shown at *W* in the illustration has an external thread of the British Association Standard form. The rounded tops and bottoms of this type of thread permit the metal to flow more easily into the die cavity than the threads of the United States standard or the V-shaped form.

The first step in making these caps is the heading of balls or slugs of a given diameter from wire of the desired composition. This is usually a lead and tin, or a lead, tin, zinc, antimony, and bismuth, (or cadmium) composition. After the slugs are headed and trimmed, they are ready to be extruded in the die. An operator can head as many as 1100 caps an hour by placing one slug at a time in the die. Production could, of course, be increased by providing a metering chute feed and an air blast to force the finished pieces out of the die at the rear of the press.

The die is composed of two sliding plates *A* which are normally held apart or open by springs *S* when the punch is up. On the down stroke, the cams *B* force plates *A* together and hold them shut while the punch performs the extruding operation. In operation, a slug is dropped into place and the punch descends. This actuates the knock-out bar, causing the shedder *C* to drop to its low position. Three equally spaced small springs, one of which is shown in the lower view, assist in forcing shedder *C* down. Continued downward movement of cams *B* serve to close the die and hold it shut until the extruding operation is completed.

Punch *D* next makes contact with slides *A*, completely enclosing the slug. Further downward movement causes the punch *D* to force the metal in the die to flow out into the head and thread sections as shown. On the upward stroke of the ram, the various die members pass through the cycle of movements in the reverse order, leaving the finished blank on top of the knock-out *C*, ready to be pushed out through the back of the die or blown out by a blast of air. The two cam bars *B* also act as pillars to insure accurate alignment of the die and punch. In order to keep close contact between plates *A*, wear-resisting strips *H* are provided, which may be shimmed or replaced to take up wear.



Extruding Die for Producing Soft Metal Caps W

* * *

Burnishing rollers of a hard, wear-resistant alloy last so long and retain such a high finish that they are now being used in many railroad shops for finishing car axle journals. Double opposed rollers of Stellite in a standard car axle burnishing machine have already finished over 21,000 journals in one shop. They have not been out for repairs in five years of service, and are still as good as new.

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

B. A.—Is stainless steel acid-resistant?

A.—According to *The Enduro Era*, published by the Republic Steel Corporation, Massillon, Ohio, this question can be answered only by considering what acids are referred to. The term "acids" covers a very broad field. There is no one metal that can resist the action of all types of acids. Stainless steel is resistant to nitric acid, some concentrations of sulphurous and sulphuric and practically all of the organic acids, such as tartaric, butric and other fatty acids commonly encountered in food products. It is not resistant to muriatic, hydrofluoric, or any of the halogen acids.

Can a Salesman Make a Contract that is Binding upon His Employer?

U. T.—Some time ago one of our salesmen made a contract with one of our dealers and, without our authority, the salesman contracted to give the dealer exclusive sales rights in a certain locality. Now, this dealer expects us to fulfill the contract, although the salesman no longer represents us. Are we bound by this contract? Can we hold the salesman personally liable for damages for making the contract without authority?

Answered by Leo T. Parker, Attorney-at-Law
Cincinnati, Ohio

Obviously, an employe may be personally responsible on a contract (1) if he knowingly makes a false written or oral statement or representation of his authority, with intent to deceive a person who intends to transact business with the employer; (2) if he performs any unlawful act with or without authority of the employer; (3) if he performs a damaging or injurious act, believing that he has authority, though he actually has none; (4) if he wilfully performs an act which results in damage to any one; (5) if he does damaging acts outside his scope of authority, although while so doing he intends to render the employer a valuable service; (6) if he intentionally assumes an obligation for the employer without authority; or (7) if he unintentionally, but legally, assumes an obligation while performing services for his employer.

A review of past higher Court cases disclosed an important rule by which it may be determined when an employe or representative may make a valid contract. He may do so only under the following circumstances: (1) An agent can only make a valid contract for an employer when the contract is within the limit of the agent's authority. (2) Although persons dealing with an agent must inquire ordinarily as to the extent of the authority, this is not true when the employer sends the agent to perform an act with apparent broad authority. (3) When the authority to perform an act is given by an employer to an agent or representative, the agent may do the work or service as he may deem best. (4) If the agent is a special representative and his authority is limited, and the employer has not in some manner notified the public that the agent has broad or unusual authority, then under no circumstances may the agent make a valid contract without first submitting the contract to his employer for approval. (5) Any agent, no matter how limited his authority may be, can have his authority greatly increased if the employer notifies the person with whom the agent intends doing business of this increase of authority.

Therefore, it is my opinion that you are not liable on the contract, and that the salesman is personally liable.

* * *

Centenary of the American Patent System

The one-hundredth anniversary of the founding of the American Patent System will be celebrated in Washington, D. C., on November 23. Dr. Charles F. Kettering, president of the General Motors Research Corporation, has accepted an invitation of the Secretary of Commerce to serve as chairman of the national committee that will be in charge of the celebration. It is expected that there will be a meeting on the morning of November 23 in the auditorium of the building of the National Academy of Science, and that in the afternoon there will be demonstrations of new inventions just on the threshold of usefulness. In the evening, a dinner will be given in commemoration of the event at the Mayflower Hotel. At this dinner, the guests will hear one of the two original Morse telegraph instruments receive a message from Baltimore. Thomas Edison will address the guests in his own words, from one of his early phonograph records.

Ideas for the Shop and Drafting-Room

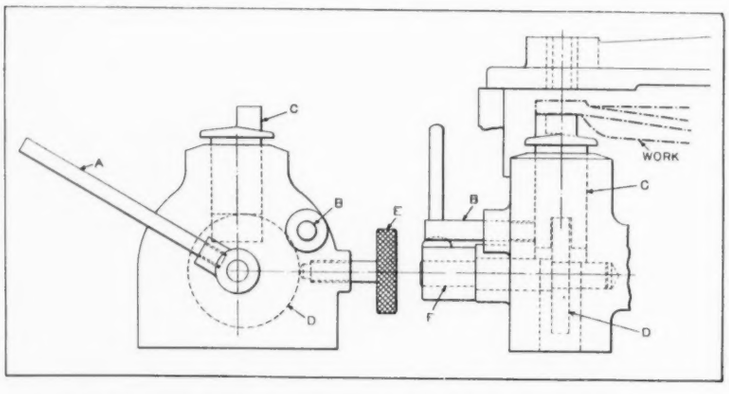
Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

A Self-Adjusting Stop-Pin for a Milling Fixture

A self-adjusting stop-pin for supporting work in a drilling or milling fixture is shown in the accompanying illustration. This pin is designed for use in place of the ordinary type of spring pin. It consists of four main parts —the work-supporting stop-pin *C;* the eccentric *D;* the lever *A* and its stop-pin *B;* and the clamping screw *E*.

In operation, the lever *A* is thrown back against the stop *B* to lower the stop-pin *C*. The work is then placed in the fixture and the lever *A* thrown forward to raise the stop *C* through the medium of the eccentric *D*. This brings the stop in contact with the work in the fixture. The binding or clamping screw *E* is then tightened to hold the eccentric *D* in position, thus making the work ready for the machining operation.

The lever *A* is light in weight, being just heavy enough to turn the eccentric *D* when moved past the center of the eccentric shaft *F*. By allowing the weight of the lever to bring stop *C* against the work, there will be no danger of raising the work,



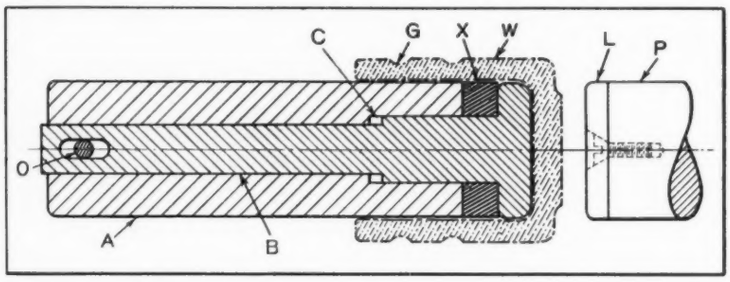
Self-adjusting Stop for Supporting Work in a Jig or Fixture

and each piece will be supported uniformly. This feature permits using the stop for very light work. The center of the eccentric *D* being nearly on the center line of the stop-pin *C* enables this member to support heavy thrust loads without danger of slipping.

North Leominster, Mass. ROBERT H. HOLTON

Expanding Arbor with Rubber Gripping Member

In devising a rapid method for cutting decorative grooves in die-castings, the writer developed the expanding arbor shown in the accompanying



Expanding Arbor of Simple Construction

illustration, which has an effective gripping member made of rubber. The zinc alloy cup *W*, which is required to have decorative grooves turned on the outside, as indicated at *G*, has an inside diameter of 1 1/2 inches, an outside diameter of 1 3/4 inches, and a length of 2 1/2 inches.

The arbor has a machined steel member *A*, which is chucked 3 inches from the end and is turned to a diameter of 1.498 inches. Plunger *B* is a sliding fit in member *A* and has a clearance of 1/8 inch at *C*. Pin *O*, which passes through a slot in the plunger, serves to keep the parts assembled. The rubber ring *X* is turned to a diameter slightly less than 1 1/2 inches and fits over plunger *B*.

In operation, the cup *W* is placed over the rubber ring, with the bottom resting against the end of plunger *B*. The placing of the work on the arbor can be accomplished while the spindle is running. A moderate pressure of the turret plug *P*, equipped with a leather pad *L*, serves to expand the rubber ring sufficiently to grip the work while the grooves *G* are being turned.

Cleveland, Ohio LLOYD J. HERRIMAN

* * *

The man who is wrong is usually cocksure; he who is right is open to conviction.

Recent Developments in Methods and Equipment for Plastics

By HERBERT CHASE

New Features are Incorporated in Molding Presses and Special Machines Installed in Million-Dollar Plants Recently Built for the Production and Molding of Plastics

SELF-CONTAINED hydraulic molding presses capable of exerting tremendous pressure, light-duty presses for holding molded parts while they are cooling, and special machines for cutting and finishing laminated and cast plastic materials are recent developments for plants fabricating plastics.

Presses are the most important equipment used in working plastics. They are employed for molding, as well as for making, laminated products. There are, however, types of plastics that never come in contact with a press and that are worked on machines of the same general types as those used for metals. Many moldings require some machine operations, and nearly all laminated plastics must be machined.

The new Ford plant for producing and molding plastics will cost several million dollars and will be equipped with several hundred presses and many other machines. At least two other companies have plants under construction for the production of new forms of plastics which involve the investment of millions of dollars in new equipment.

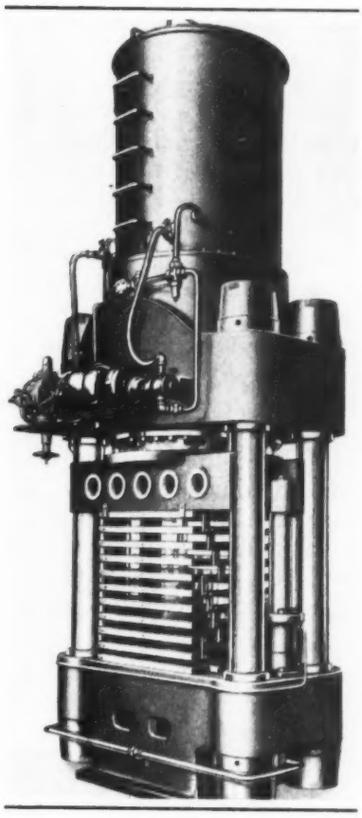


Fig. 1. Hydraulic Press Developed for Plastic Molding and Laminating Operations Requiring Pressures up to 1750 Tons

Self-Contained Molding Press Developing 1750 Tons Pressure

There is a growing tendency to make the larger molding presses self-contained units with integral motor-driven pumps, thus eliminating the need for independent high-pressure systems. Some of the latest presses have solid slabs connecting the upper and lower portions of the press in place of the usual tie-bars of circular section. These side slabs provide flat ways or guides for the platen.

The Hydraulic Press Mfg. Co. has recently built a heavy press of the self-contained type for the Detroit Paper Products Corporation. This press, Fig. 1, exerts a total pressure of 1750 tons and is said to be the most powerful of its kind yet built for the working of plastics, although some presses built for laminating purposes have a larger platen area. It has a single ram 48 inches in diameter, which virtually covers the whole platen area. This feature provides uniform pressure, with little or no tendency to distort the platens, as may happen when two or more rams are used. Two relatively small side rams are provided for opening the press.

The press is actuated by a variable-displacement pump, direct driven by a 20-horsepower motor. Both the motor and the pump are mounted on the upper head of the press and require no extra floor space. The pump is a high-speed type, operating at 1200 revolutions per minute; it does not require a large accumulator, as do the older, slow-speed pumps.

The pump is of the positive-displacement radial-piston type and is designed to run continuously. It will deliver 20 gallons per minute at a pressure of 1500 pounds per square inch. The variable stroke is adjusted by an automatic pressure controller which increases the stroke for fast low-pressure operation and decreases it as the pressure builds up to the maximum for which the controller is set. The pump is then automatically held at nearly zero stroke, delivering just enough oil to follow any change in the material being pressed

and maintaining the pressure within very close limits as long as required. The press is actuated by simply shifting the operating valve handle to the required position.

At present, this huge press is used for pressing phenolic materials into laminated sheets which are subsequently cut up into breaker strips for refrigerator doors, but it is planned to use this and similar presses for making large flat molded parts such as may be required in trimming automobile interiors.

Supplementing the press, a series of several more or less conventional machine tools is used for cutting the breaker strips from laminated sheets. These strips average around 1 1/2 inches wide and about 1/8 inch thick, and are made by cutting up sheets 48 inches square on a flat-bed circular saw. The high-speed steel saw developed for this purpose will cut 4000 strips 48 inches long per eight-hour shift. The strips are then put through a machine having a 4-inch Carboloy-tipped cutter, which is rotated at high speed, for shaping the edges to the required radius or bevel. This machine handles about 2000 feet of strip an hour.

Another circular saw with the bed tilted to give the required angle cuts the shaped strips to length and miters them, after which they are shifted to a multiple-spindle machine, which drills and countersinks all screw holes in a single operation. The edges of the strips are then waxed and buffed on an ordinary buffing wheel, after which they are ready for shipment.

It was originally planned to mold the breaker strips complete with the holes and edges formed, but the great variety of lengths and other dimensions required by the electric refrigerator manufacturers made it necessary to follow the procedure outlined.

Development of Slab Side Presses

The improved practice in the new molding department of the Ford River Rouge plant has led to the development of new presses by at least three outside producers. One of these, the Farrel-Birmingham Co., has produced a new press of 100 tons capacity with platens 20 by 20 inches. The operating pressure is 2500 pounds per square inch on a 12-inch ram.

This press has solid slab-steel side plates which are slotted to provide ways for the up-acting lower platen. A wedge adjustment of the side plates is provided for use after any initial stretch has taken place. This press also has a self-contained hydraulic system, the pump and its 15-horsepower driving motor being mounted on top of the fixed upper cross-head which serves also as an oil tank. The entire press is controlled by a single valve.

After assembly, the press and its actuating mechanism are covered with a sheet-metal housing hav-

Fig. 2. Straight-side Plastic Molding Press Equipped for Producing Window Frames for Ford Cars

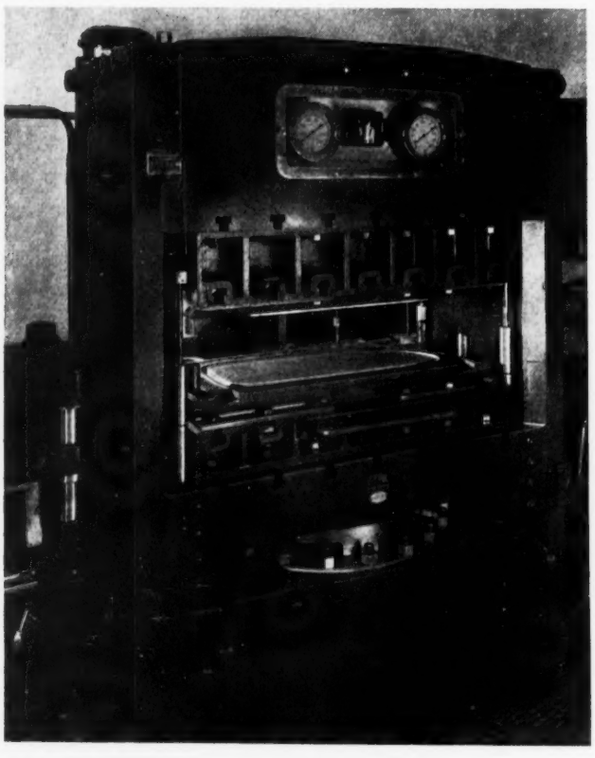
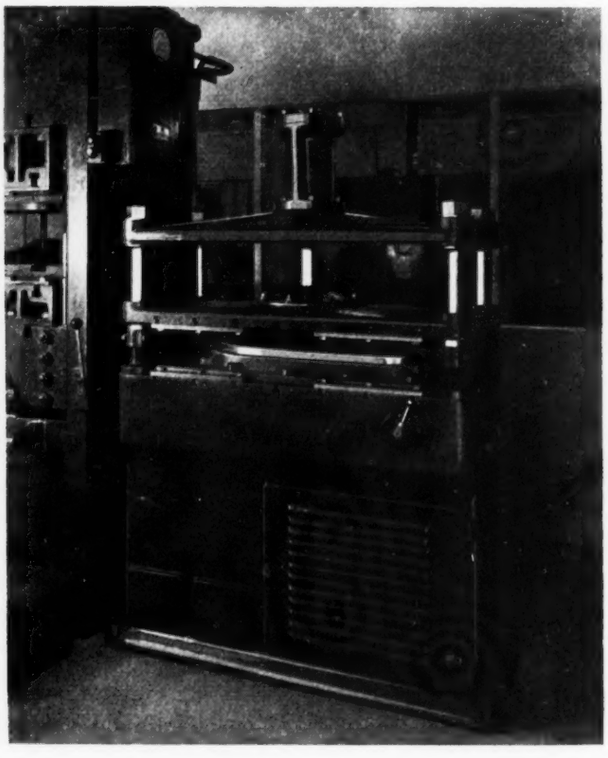


Fig. 3. Press Designed to Receive Moldings from Machine Shown in Fig. 2 and Hold them while Cooling



ing a recessed panel for the operating gages. This press, which was described and illustrated in February, MACHINERY, page 416, has a 12-inch stroke. A much larger size, 30 by 60 inches, has also been built to substantially the same design for the Ford laboratory.

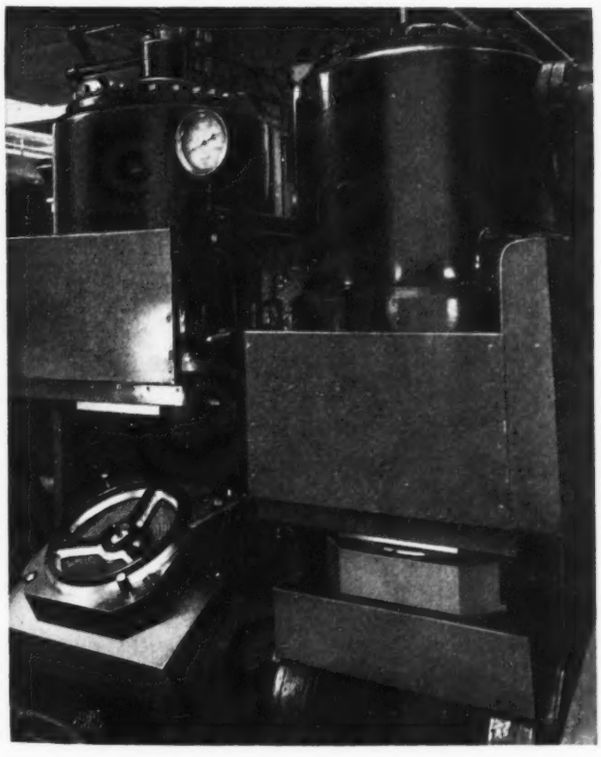
The French Oil Mill Machinery Co. has also supplied, for Ford's use, the new design, 530-ton press shown in Fig. 2. Several of these presses are already installed in the molding plant adjacent to the new equipment for producing the phenol-formaldehyde-soy-bean plastic which Ford is beginning to use in molded window frames for closed bodies. As the largest of these frames measures 13 1/2 by 34 inches, a powerful molding press is required. This press has flat slab sides beveled at the inner edges to provide ways for the movable platen which is actuated by a single upward-acting ram.

These presses are self-contained units with built-in pumping equipment. There are controls for automatically holding any desired pressure within the pump capacity. The valve equipment gives automatic timing and control of the operation. The presses have a 12-inch stroke and the platens measure 30 by 52 inches. The heavy side plates and flat ways are said to be much more rigid than the conventional tie-bars, and there are no nuts to work loose and cause misalignment of the press.

These molding presses are set between cooling presses of lighter construction. The latter presses, Fig. 3, were designed and built by Ford engineers. They have a downward-acting platen with a small central ram, the platen being guided on the tie-bars. As soon as a molding is cured in the hot molding press, it is transferred to the adjacent cooling press where it is kept under light pressure merely to prevent it from warping while cooling. These light presses are arranged for rapid operation.

When cooled, the molded frames go to special machines for drilling the holes for the screws that hold the frames to the body of the car. After being drilled, the frame is ready for assembly in the body. Unlike the metal frame, the molded frame requires no applied finish, is free from corrosion, and its surface is not easily marred.

Fig. 4. New Type of Tilting Press Equipped for Molding Rubber on Metal Steering Wheel Spiders



Tilting Press for Molding Steering Wheels

In the older molding department of the Ford plant, a new type tilting press has been installed for molding steering wheels from rubber. In this press, Fig. 4, the metal spider for the steering wheel is inserted between two square sheets of rubber compound. The press is then closed, causing the rubber to be molded around each of the metal parts, and the excess flash to be sheared away. This operation takes about one minute. Upon the completion of the operation, the flash is returned to the compounding mill and reworked. The wheels thus formed are ready for vulcanizing.

In the older process of making steering wheels, the rim was first covered with an extruded channel of rubber, the spokes with strips, and the hub with disks of rubber, after which the wheel was vulcanized in a press for twelve minutes, with considerable loss in flash. The new molding method not only saves time, but avoids waste in material. One man operates two presses, charging one while the wheel has a short cure in the other. The wheels are then vulcanized in stainless-steel vulcanizers in lots of about 200.

Injection Type Molding Press

Besides the improvements in common types of presses for molding plastics, much has been done in the development of special forms of presses. One development is the injection type molding press, designed for use with thermo-plastic materials, such as cellulose acetate.

Many small parts are being injection-molded. In this process, a supply of the plastic material is maintained in the liquid state in a heated cylinder from which it is ejected into a cold mold by hydraulic pressure. There the plastic hardens quickly, permitting the molded parts to be ejected almost immediately. The process is more or less analogous to die-casting, but requires very high pressure because of the rather viscous materials commonly used.

The Hydraulic Press Mfg. Co. is making presses of this kind for several molders of plastics. The

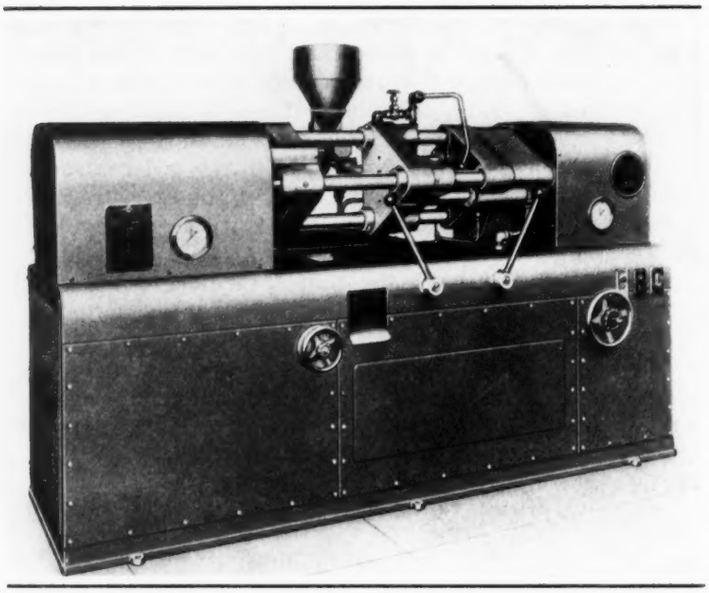


Fig. 5. Injection Type of Molding Press Arranged for Hydraulic Operation, Capable of 240 Cycles an Hour

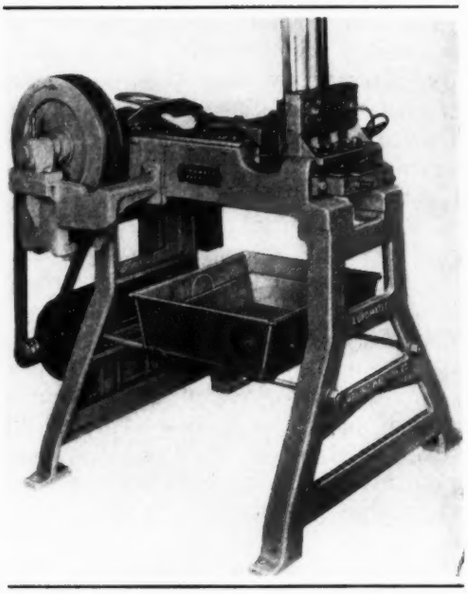


Fig. 6. Machine for Cutting Blanks from Rods and Tubes of Plastic Materials

latest machine, Fig. 5, has horizontal hydraulic and injection cylinders and a mechanism for rapid hydraulic opening and closing of the mold. The machine is capable of 240 or more cycles an hour and is self-contained, being fitted with two variable-displacement, automatically controlled, radial-cylinder pumps for pumping the fluid under pressure.

Injection molding appears to have great future possibilities. Some work has already been done in producing parts with die-cast metal cores over which cellulose-acetate coverings of great beauty and serviceability are injection-molded. Much is likely to be heard of this development if it proves as successful as seems probable in view of recent experiments.

Machining Cast Plastics

Some development has taken place recently in special machines for machining plastics that are cast or otherwise produced in the form of rods, tubes, slabs, sheets, and special shapes. There has been a considerable increase in the production of cast phenolic plastics, and there is much competition in machining and finishing more or less standard products, especially buttons and buckles cut from rods and tubes of this and similar plastics. Such materials can be machined on screw machines, but blanks are often cut off with thin abrasive cutters.

An important improvement has been made recently in machines for cutting off plastic rods, especially those used in making button blanks. This has been done successfully for some years with casein rods before they are hardened, but has proved somewhat more difficult with cast phenolics, partly because the material is harder than the uncured casein and partly because of other physical characteristics. There is available now, however, at least one make of machine for this purpose.

As shown in Fig. 6, this machine, called the "Lupomatic" cleaving machine, has a reciprocating knife in a crank-actuated slide. Bar or tubular stock is first heated outside the machine to soften it, and is then slipped vertically into an electrically heated holder. The stock is fed down automatically against an adjustable stop, and is cut off into blanks from 0.040 to 1.5 inches thick in the forward motion of the reciprocating knife. The blanks drop into a basket in a pan of water.

As the machine makes 175 to 225 cutting strokes a minute and three or more rods or tubes, depending on the diameter, can be cut at each stroke, the production rate is very high. The blanks are usually finished on automatic machines or punched and formed in special button and buckle presses. The removal of tool marks and polishing is generally done by tumbling.

Improvements Affecting Molds for Plastics

As the cost of molds for plastics often involves a considerable investment, numerous efforts have been made to reduce this cost and much has been accomplished by developments in die-sinking machines.

If fairly wide tolerances are permitted, as in certain forms of decorative products where a machined mold would be prohibitive in price, there is a field for cast molds, and some recent developments in this field have given excellent results. This applies especially to the beryllium-copper or bronze molds.

Beryllium copper, when properly heat-treated, has an ultimate tensile strength of about 150,000 pounds per square inch; an elongation of about 2 per cent in 2 inches; and a Brinell hardness of 360. It is cast with an excellent surface that takes a high polish but may show occasional small surface blemishes which are of little or no consequence in decorative work. Some trouble with porosity was encountered for a time, but reports indicate that this has been overcome by using fairly thin sections for the face of the mold — say, about 1/2 inch maximum—and backing this, when required, with a less expensive type of bronze which can be joined to the beryllium copper by a sweating operation. Many beautiful moldings have been produced in molds made in this way, which cost from one-half to one-third less than the equivalent steel molds.

Channeling for steam or water passages can be formed by cores when casting. The molding surfaces are finished by using light abrasives and buffing. Although these molds can be machined to secure dimensional accuracy, there may be little or no advantage over a steel mold machined from a billet or slab if much machine work is required. When decorative surfaces such as would be difficult to machine without expensive hand engraving are wanted, however, and close dimensions are not essential, this type of mold promises to be highly satisfactory.

* * *

Speeding up the Inspection of Rollers for Needle Bearings

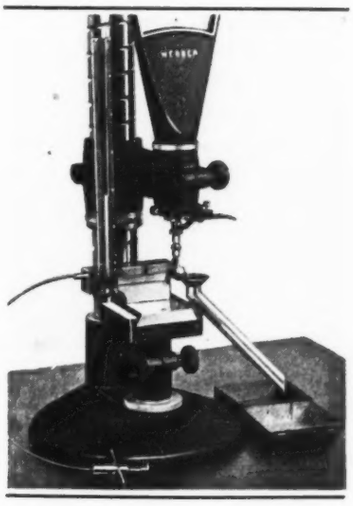
The accompanying photograph shows an inspection gage made by the Webber Gage Co., Cleveland, Ohio, applied to the inspection of needles for tiny needle bearings. The rollers inspected are 0.119 inch in diameter, and by means of the gage, they are separated into five different ranges of sizes or steps, each range varying from the next by 0.00005 inch. Using a micrometer, one man was able to gage about 200 of these needles an hour. With the equipment shown, one operator can easily gage 1800 an hour. The device is provided with a hopper feed and camera wire pusher device. The operator simply pushes on this device with his left hand, and noting the dial reading, he moves the receiver pipe over any one of the boxes that receive the needles. In the illustration only two boxes are shown; but obviously, the number of boxes corresponds to the number of size ranges.

* * *

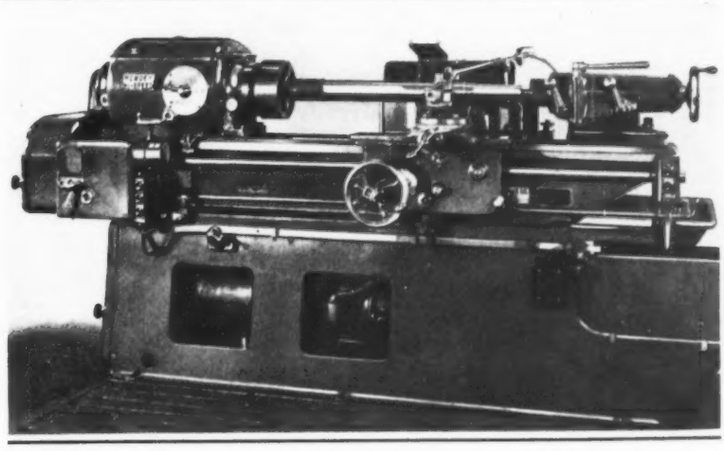
Noteworthy Savings in Engine Lathe Turning

The modern engine lathe has cost-saving possibilities, the same as more recently developed automatic and semi-automatic machinery. The Hartford Special Machinery Co., Hartford, Conn., reports considerable savings through the use of a Hendey No. 3 Hi-Speed step-turning lathe, equipped with a New Departure variable-speed Transitorq. The variable-speed power unit enables the operator to select exactly the speed required for a given cut, and this, in connection with the modern design of the lathe, has made a large time reduction possible, as compared with the use of older equipment.

In the accompanying illustration is shown an example of a job on which the reduction in turning time was more than one-half. Three other examples may be cited. In one instance, one end of a rack is turned in 18 minutes, as compared with 60 minutes on older equipment. In another case, a spindle about 14 inches long with numerous shoulders is turned in 35 minutes, as compared with 90 minutes; and a shaft 19 inches long, also having numerous shoulders, is turned in 25 minutes, as compared with 75 minutes formerly. In the illustration, the doors in the base are removed to show the power drive mounting.

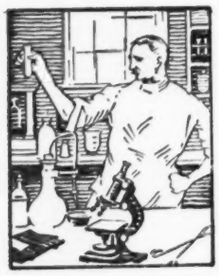


Inspecting Needles for Tiny Bearings with a Webber Gage



Hendey Hi-Speed Lathe Equipped with a New Departure Transitorq, which Reduced the Turning Time on the Work Shown One-half

MATERIALS OF INDUSTRY



THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Molded Plastic Resists Heat up to 450 Degrees F.

Parts molded from a synthetic plastic now being announced by General Plastics, Inc., North Tonawanda, N. Y., are not affected by temperatures up to 450 degrees F. This material is therefore suitable for manufacture into electric-iron handles, appliance plugs, and other parts that must retain their dielectric strength without carbonization under relatively high temperatures.

The new material is available in black and brown colors which are known as Nos. 34 and 37. It can be molded almost as rapidly as standard materials.

Drawing Dies Cast from Iron Alloys are Long-Lived

Dies cast from nickel-chromium alloys and heat-treated have proved unusually successful in a number of sheet-metal stamping and drawing operations, according to the *Nickel Cast Iron News*, published by the International Nickel Co., New York City. The alloy compositions for this service have a nickel content of from 2 to 4 per cent and a chromium content of from 0.75 to 1 per cent. These nickel-chromium alloys can be easily heat-treated, possess a fine grain structure, take a high polish, and eliminate streaking of the metal being formed.

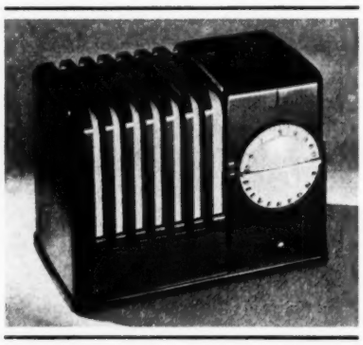
One set of dies cast from Paraloy No. 2, which is a product of the Youngstown Foundry & Machine Co., Youngstown, Ohio, has already produced over 176,000 cylindrical washing machine tubs, and it is estimated that a similar number can be produced before redressing of the dies is necessary. Unalloyed cast-iron dies used in this service had to be redressed at least after every 10,000 tubs had been produced and sometimes after the shaping of only 2000 tubs.

Paraloy No. 2 has a Brinell hardness of between 250 and 300 before heat-treatment, and a tensile strength ranging from 40,000 to 50,000 pounds per square inch. After heat-treatment, the hardness is from 450 to 550 Brinell, and the tensile strength is between 30,000 and 40,000 pounds per square inch.

Low-Carbon Steels for High-Temperature Service

Two low-carbon, low-alloy steels—Sicromo and Silmo—shown at the National Metal Exposition by the Timken Steel & Tube Co., Canton, Ohio, were developed during recent months for use primarily in the power and oil-refining industries, where high temperatures are an important factor. The physical properties, composition, and applications of Silmo were described in June MACHINERY, page 674.

Sicromo steel is suitable for applications in which corrosion resistance is a major consideration, but where conditions do not warrant the selection of the higher priced 4-6 per cent chromium-molybdenum steel. It compares favorably with the latter steel with respect to stability, strength, and oxidation resistance, and behaves similarly in weld-



In a Recently Conducted Modern Plastics Competition, the Jury, which was Composed of Well-known Designers and Engineers, Awarded First Prize in the Decorative Division to the Sears Roebuck Radio Here Illustrated, which has a Case Entirely Molded from Durez Plastic Material

ing operations and fabrication. The new alloy is especially intended for cracking furnace tubes, vapor and hot oil lines, superheater tubes and piping, and various other products exposed to heat and corrosion by oil.

The chemical composition of Sicromo is as follows: Carbon, 0.15 per cent maximum; manganese, 0.50 per cent maximum; phosphorus, 0.03 per cent maximum; sulphur, 0.03 per cent maximum; silicon, 0.50 to 1.00 per cent; chromium, 2.25 to 2.75 per cent; molybdenum, 0.40 to 0.60 per cent.

Tests conducted on specimens annealed at 1550 degrees F. as a preliminary heat-treatment have shown that at 85 degrees F. the ultimate tensile strength is 74,400 pounds per square inch; the yield strength, 40,650 pounds per square inch; the elongation in 2 inches, 38.5 per cent; and the reduction of area, 72.6 per cent. At a temperature of 750 degrees F., the ultimate tensile strength is 62,450 pounds per square inch; the yield strength, 26,600 pounds per square inch; the elongation in 2 inches, 30.5 per cent; and reduction of area, 67.4 per cent.

At a temperature of 1100 degrees F., the ultimate tensile strength is 36,500 pounds per square inch; the yield strength, 20,000 pounds per square inch; the elongation in 2 inches, 50.3 per cent; and the reduction of area, 85.4 per cent. At a temperature of 1400 degrees F., the ultimate tensile strength is 12,900 pounds per square inch; the yield strength, 7500 pounds per square inch; the elongation in 2 inches, 75 per cent; and the reduction of area, 96 per cent.

Airplane Engine Crankshaft Made of Nickel-Chromium-Molybdenum Steel—a Mechanical Feature of this Crankshaft is an Ingenious Balancing Arrangement

Molybdenum steels of various analyses are used for important parts of the aircraft engines built by the Wright Aeronautical Corporation, Paterson, N. J., according to the *Moly Matrix*, published by the Climax Molybdenum Co., New York City. For example, two types of steel are used for cylinders, the kind being determined by the engine horsepower. Whirlwind engines up to 500 horsepower are made of chromium-molybdenum (SAE 4140) steel, while Cyclone engines from 750 to 1000 horsepower are made of Nitralloy.

The analysis of the Nitralloy steel used for this application is as follows: Carbon, from 0.38 to 0.45 per cent; manganese from 0.40 to 0.70 per cent; phosphorus, 0.04 per cent maximum; sulphur, 0.04 per cent maximum; chromium, 1.40 to 1.80 per cent; aluminum, 0.95 to 1.35 per cent; and molybdenum, from 0.30 to 0.45 per cent.

This analysis gives a high surface hardness and resistance to wear, together with minimum distortion after nitriding. Other applications of Nitralloy include reduction gears, knuckle pins, spiral drive gears for oil pumps and miscellaneous parts.

Crankshafts and propeller shafts are made from an alloy having the following composition: Carbon, 0.35 to 0.45 per cent; manganese, 0.60 to 0.80 per cent; chromium, 0.70 to 0.90 per cent; nickel, 1.25 to 1.75 per cent; and molybdenum, 0.15 to 0.25 per cent. Nickel-chromium-molybdenum steel is also used for connecting-rods. A chromium-molybdenum steel (SAE 4130) is used for oil lines, washers, etc.

Molybdenum Steels Used in Building Aircraft Engines

The development of aircraft engines to their present high state was largely made possible by a parallel development in alloy steels. The manufacturers of airplane engines demand high quality above everything else when it comes to the selection of materials.

Enamel Finish for Zinc and Aluminum Die-Castings

Air-drving lacquer enamels which are said to adhere tenaciously to zinc and aluminum die-castings are being introduced on the market by the Maas & Waldstein Co., Newark, N. J. These lacquer enamels produce a durable elastic finish in one coat.

Machine Tool Builders Discuss Problems of the Industry

Standardization, Foreign Trade, Depreciation, and Credit and Public Finance were among the Subjects Discussed at the Machine Tool Builders' Annual Meeting

THE thirty-fifth annual convention of the National Machine Tool Builders' Association, held at the Homestead, Hot Springs, Va., October 5 to 7, was attended by a larger number of members than any convention for several years. The subjects dealt with were of a character that commanded the close attention of all engaged in the industry.

The president of the Association for the past year, Norman D. MacLeod, president of the Abrasive Machine Tool Co., Providence, R. I., in his address, after briefly referring to the problems that have been occupying the members during the past year, suggested a platform for the machine tool industry that might equally well be adopted as a platform for the machinery industries in general. The planks in this platform gave expression to such fundamental principles of business conduct that they well deserve to be placed permanently on record. Mr. MacLeod presented ten planks in this platform as follows:

Blackstone Studios

Clayton R. Burt, New President of the National Machine Tool Builders' Association

1. We recognize the advantages of business competition under a democratic form of government and under the American standard of living, and pledge ourselves to adhere to this principle in an energetic but clean and honest manner. Competition leads to improvements in products, better manufacturing and management methods, more economical selling and distributing practices, and a lowering of prices to the consumer.

2. We believe that our industry is unalterably tied in with the welfare of other industries and other lines of endeavor, and pledge ourselves to be tolerant in our attitude toward them. These industries are our consumers and must be fathered. No part of an integral body politic may become diseased without affecting other parts sooner or later. Prosperity must come to all the people or our own will not last long.

3. We believe in the advantages of cooperative effort, and, therefore, pledge our utmost support to our own Association, and to such other national or local organizations as are honestly and legitimately endeavoring to raise the standard of living. Associations such as ours breed confidence, promote social intercourse, broaden one's viewpoint. They can be of great value in raising standards of business relations, management and manufacturing methods, and promoting better understanding between competitors.

4. We believe in our democratic form of government as provided for in the Constitution of the United States, and pledge ourselves to take an active interest in national and local political affairs. Too many business men close their minds to politics, forgetting that their own financial and physical welfare is thereby jeopardized. These same men are often the loudest critics when in non-political circles, whereas they should be advancing constructive ideas where they will do the most good. The charge that business men should not dabble in politics has no defense whatsoever. Business has the biggest stake in government and pays most of the bills. The Constitution guarantees the right to protect that stake.

5. We believe in the profit system and pledge ourselves to so manage our business that the greatest value will accrue to investor, workman, and consumer. This industry would be derelict in its duty to the public if it did not earn enough to insure new developments for greater production, sufficient surplus to carry it and its organization through dull periods, and to supply its plants with modern equipment. Lack of profits destroys ambition and morale, decreases credit, leads to questionable sales tactics, and generally produces failures.

6. We realize the damage done to our competi-

tors and the general economic structure through the marketing of a product at prices below normal costs, and pledge ourselves to discontinue products which do not have a promise of showing reasonable profits. It is assumed that a new product will sometimes fail to show a profit until it has become established in the market. There are many items, however, which are marketed year after year at the expense of another product or products. Such a practice is uneconomical to a degree seldom realized by the manufacturer doing it.

7. We recognize the value of maintaining a sound partnership with our workers, and pledge ourselves to strive continually to improve their conditions. A manufacturing business is a real partnership between management and workers, and cannot survive without both. Efficient and understanding cooperation is required on the part of both, but must start and be fostered from the top. Our workers have a right to know and understand everything except the most confidential aspects of our business.

8. We recognize the fluctuations in world economic conditions causing periods of prosperity and depression, and pledge ourselves to do our part to help in balancing production and consumption. This help may be given in many ways, the first requirement being to establish sound policies on a long-term basis. Steady employment of our workers, refraining from speculation in any form not backed by true wealth, and guarding against overexpansion, are items of prime importance in maintaining the desired conditions.

9. We pledge ourselves to common decency in business as expressed in our own code of ethics, believing that adherence to the principles therein will lead to a better understanding of our industry, freedom from unnecessary friction with our competitors and our customers, and a business standard above reproach.

10. Finally, we realize the important place our industry enjoys in the American standard of living and in human welfare generally, and pledge ourselves to strive for even greater standards so that this position may be maintained. Modern comforts and necessities are dependent upon the machine tool. Further progress is dependent upon it. More goods at lower prices, so that more people may enjoy them, are wholly dependent upon it. We may rightfully be proud of our calling. We are in duty bound to revere and protect it.

The general manager of the Association, Herman H. Lind, in his report to the members, dealt with a number of the immediate problems of the machine tool industry, including several problems that have been created by recent business legislation. Foreign affairs were dealt with in brief addresses by F. H. Chapin, president of the National Acme Co., S. T. Massey, vice-president of the Heald Machine Co., and J. E. Lovely, chief engineer of the Jones & Lamson Machine Co., all of whom were abroad this summer and who related their impressions of conditions in several European countries.

Electric motor standardization was dealt with in a comprehensive address by J. L. Hamilton, chairman of the Motor and Generator Section of the National Electrical Manufacturers Association. A paper on depreciation was presented by Paul T. Norton, Jr., of the Department of Industrial Engineering, Virginia Polytechnic Institute. In dealing with the question of depreciation, Mr. Norton avoided mere accounting technique, instead, approaching the subject from the practical point of view of the manufacturer or engineer who is not an expert accountant. This subject was also ably discussed by Eugene C. Clarke, president of the Chambersburg Engineering Co., who particularly dealt with depreciation in relation to taxation problems.

Standardization in the machine tool industry was the subject of a comprehensive report presented by F. O. Hoagland, master mechanic of the Pratt & Whitney Co. Mr. Hoagland outlined the great advance that has been made in the stand-

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Howard W. Dunbar, First Vice-president N.M.T.B.A.

Greystone Studios, Inc.

N. A. Woodworth, Second Vice-president

Henry C. Pierle, Newly Elected Treasurer

ardization of machinery and machine tool design details, and urged the use of these standards to an ever increasing extent.

A paper that was received with a great deal of interest was that on Credit and Public Finance, read by James R. Garfield, of Cleveland, Ohio. In this paper, Mr. Garfield pointed out that the cornerstone of permanent success of nations, as well as of individuals, is a reputation for honest dealings and a willingness to face facts unflinchingly and to fulfill incurred obligations. When either nations or individuals begin to side-step their obligations, their credit is impaired and their continued prosperity and welfare is jeopardized.

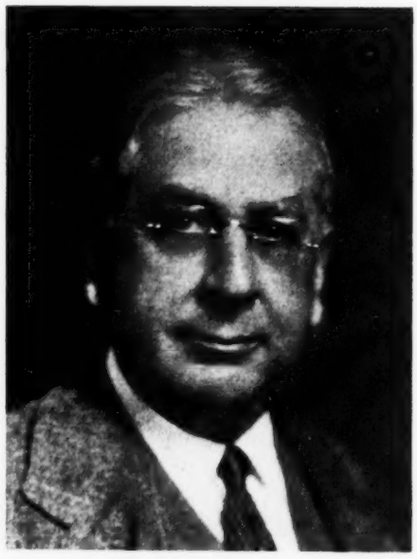
Professor E. Schell, of the Department of Business Administration, Massachusetts Institute of Technology, addressed the members on the subject "Security versus Opportunity in Business and Employment." In the course of his address, Professor Schell made many suggestions leading to new lines of thought that may prove of value to the industry.

The following officers were elected for the coming year: Clayton R. Burt, president of the Niles-Bement-Pond Co., president of the Association; H. W. Dunbar, manager of the Machinery Division, Norton Co., first vice-president; N. A. Woodworth, president and general manager of the Ex-Cell-O Aircraft & Tool Corporation, second vice-president; and H. C. Pierle, secretary and sales manager of the R. K. LeBlond Machine Tool Co., treasurer. The following new directors were elected: N. A. Woodworth; Albert J. Gifford, treasurer of the Leland-Gifford Co.; and T. H. Doan, president of the Foote-Burt Co.

James H. Herron, New President of the A. S. M. E.

JAMES H. HERRON, president of the James H. Herron Co., Cleveland, Ohio, engineers and chemists, has been elected president of the American Society of Mechanical Engineers for 1937.

Mr. Herron was born in Girard, Pa., in 1875. From 1889 to 1895, he served as an apprentice with the Sterns Mfg. Co., of Erie, Pa. From 1895 to 1909, he was engaged in engineering work with a number of companies in the capacities of assistant and chief engineer, works manager, manager, and vice-president. Since 1909 he has been president of the James H. Herron Co. He is also president of the Paragon Laboratories, director of the Baldwin Farms Land Co., and secretary of the National Engineering Inspection Association. In 1909, he received the degree of B. S. in mechanical engineering from the University of Michigan.



James H. Herron

Mr. Herron is the inventor of the air-compressor inlet-valve unloader and of numerous devices for use with air compressors and metallurgical furnaces. He is also the author of numerous articles on metallurgical subjects published in technical periodicals. As a member of the A.S.M.E., he has served on the Committee of Local Sections and has been a member of the Council.

Cemented-Carbide Prices Reduced

CARBOLOY Co., Inc., Detroit, Mich., has announced a reduction in the price of cemented-carbide tools and blanks, effective October 1. This price reduction affects all cemented carbide made by the Carboloy Co. and its licensees—the Firth-Sterling Steel Co., the Vanadium-Alloys Steel Co., the Vascaloy-Ramet Corporation, the Eisler Electric Corporation, and American Cutting Alloys, Inc. The new price of cemented-carbide blanks for tool use will be based on 45 cents per gram in any size. In addition, there will be a reduction in tool manufacturing prices effective on single-point tools in quantities of five or over for any given tool.

The object of the price reduction is to enable users to apply cemented-carbide tools more freely. It should make it possible to use these tools on many applications previously considered uneconomical or on the "border line." It will also result in additional savings on present production jobs tooled with cemented carbide, as well as on short-run, job-shop applications. The price reduction should also affect applications in the field of non-cutting, wear-resistant products, such as wear blocks, guides, grinder rests, valve stems and seats, and other parts subject to unusual abrasive or corrosive wear.

Large Farrel-Sykes Gear Generators for Soviet Russia

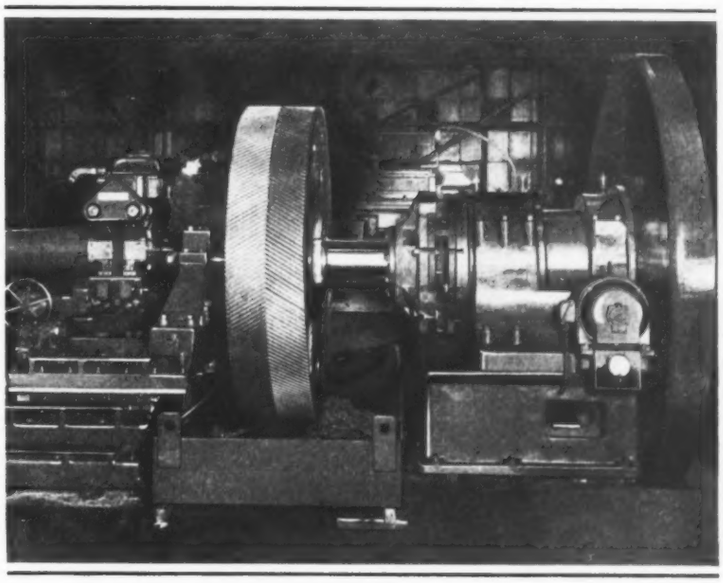


Fig. 2. A Machine for Cutting Gears up to 26 Feet in Diameter, 5 Feet in Width, and Over 6 Inches in Circular Pitch

TWO big plants have been established in Soviet Russia for the manufacture of heavy machinery, one of them at Kramatorsk near the Dneprostroi project in the south, and the other, known as the Ural Machine Works, in the north. The Kramatorsk plant was built especially for making steel rolling mill machinery.

In planning these plants, it was realized by the Soviet officials that the latest gear-cutting machinery was essential for producing the high-quality gears now used in high-speed rolling mills. Therefore, in 1934, a group of engineers was assigned to investigate in the United States the types of gear-cutting equipment available. As a result, a contract was placed with the Farrel-Birmingham Co., Inc., Buffalo, N. Y., for two huge Sykes machines.

These machines are of a similar design to six others in the Farrel-Birmingham plant, but they are considerably larger, the one intended for the Kramatorsk plant having capacity for cutting gears up to 8 meters (approximately 26 feet) in diameter, with teeth up to 50 module (6.18 inches circular pitch), and up to a maximum face width of 1 1/2 meters (about 5 feet). The total weight of this machine is approximately 265,000 pounds. The weight of the spindle which carries the cutter operating and controlling mechanisms is slightly over 35 tons.

To transport this machine from the Buffalo plant to a ship at New York City required five railroad

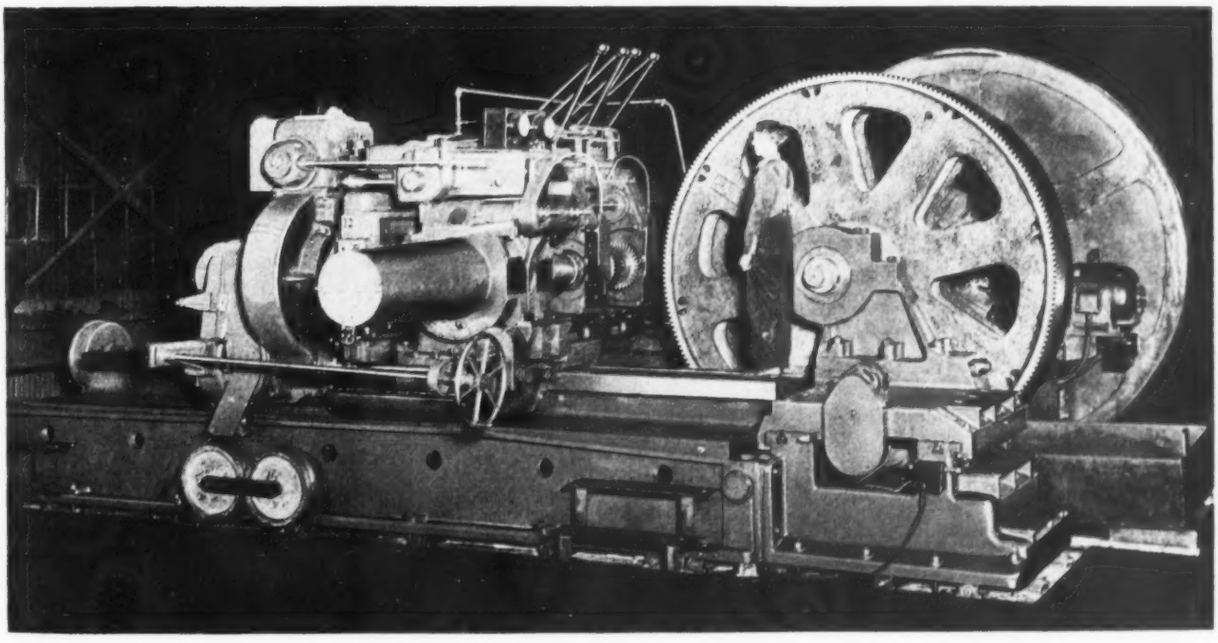


Fig. 1. Gears Weighing Approximately 50 Tons Each will be Cut on this Sykes Machine, which is One of Two Recently Built for Soviet Russia

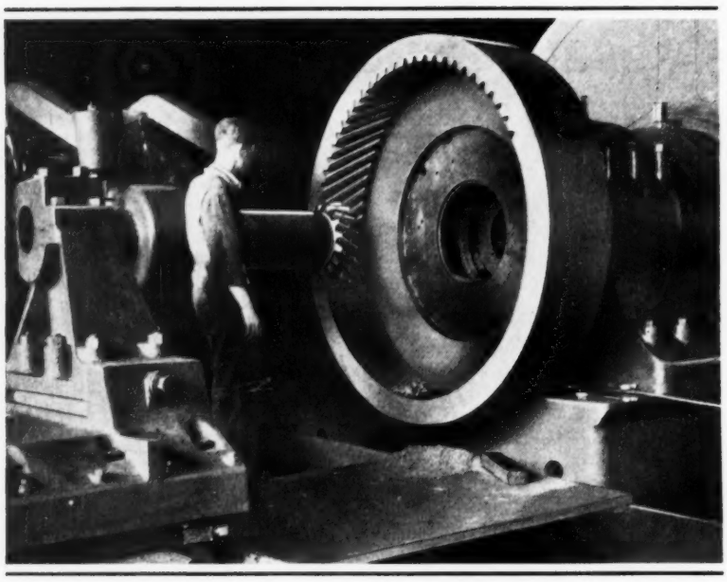


Fig. 3. Cutting a Large Internal Gear with Helical Teeth in the Machine Shown in Figs. 1 and 2

cars that were loaded almost to their limit. The over-all dimensions of this machine are approximately 38 by 26 feet. The machine for the Ural Works can produce gears up to 6 meters (about 20 feet) in diameter.

These gear-cutting machines embody many recent improvements that provide greater precision and facility of operation. They are capable of cutting practically every known type of gear used on parallel axes, including straight-tooth gears; single-helical gears; and double-helical or herringbone gears made with either continuous teeth or with a space between the rows of right- and left-hand helix teeth. In addition, the machines will cut internal gears with either straight or helical teeth.

Pinions of relatively small diameter can be cut without additional attachments. The hole in the main spindle is over 30 inches in diameter, so that pinions made integral with shafts can be cut by passing one end of the shaft through the hole in the spindle and the other end through the outer support bearing, which has a diameter of slightly more than 32 inches.

Five motors are provided on the larger of the two machines. The 40-horsepower main driving motor is mounted on the saddle of the machine to avoid the need of long driving shafts. A 10-horsepower motor rotates the work and the main spindle during setting up. A five-horsepower motor is used for the quick traverse of the main saddle along the bed. A one-horsepower motor is used for moving the heavy outer work-support, and a three-horsepower motor for driving two coolant pumps.

The electrical control equipment is designed especially for convenience of operation. There are push-button stations for starting, stopping, and jogging the machine, and also for increasing and decreasing the speed of the main motor. A tachometer dial shows the cutting speed and the number of hours that the machine has operated. An ammeter registers the current consumed.

There is a third push-button station for starting and stopping the coolant pump, and a fourth for moving the saddle along the bed in either direction. For turning the main spindle during the setting-up operation, there is a push-button station that provides forward and reverse rotation at four different speeds. A red light glows automatically if the coolant supply fails. Limit switches prevent over-traverse of the main saddle and outer work-support.

In addition to these gear-cutting machines and a set of cutters for them, complete cutter-making and testing equipment was supplied for the two plants. This included Sykes gear-tooth comparator equipment. Fig. 4 shows the largest size of comparator furnished being used for gaging the tooth thickness of a large cutter. Some of the gear-tooth generating tools used in these machines are the largest thus far made. The finer-pitch tools weigh 140 pounds each, and the largest, approximately 400 pounds each.

The designing of these gear-generating machines occupied eight engineers and draftsmen for more than one year, while the actual manufacture of the machines, the cutter-making equipment, and the cutters took about fifteen months. Although gear-cutting machines have been built before that have had as large a diameter capacity, it is believed that these machines are the largest in the world, considering diameter, width, and pitch capacities.

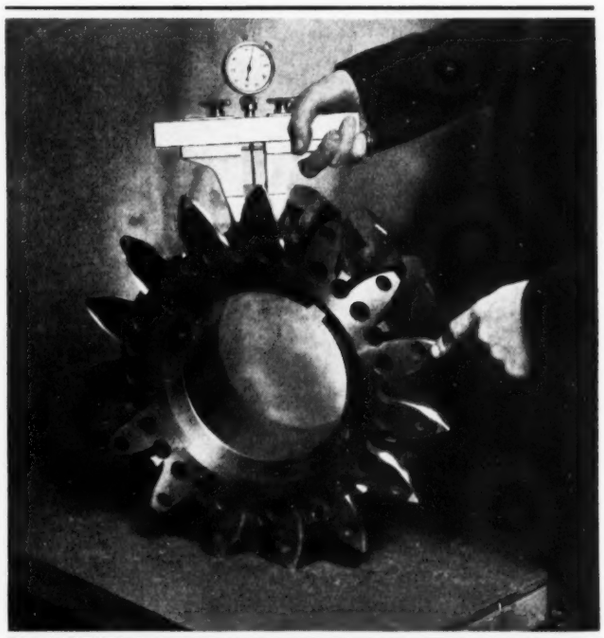


Fig. 4. Gaging the Tooth Thickness of a Large Gear-tooth Generating Tool with a Sykes Comparator

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies can be Obtained by Writing Directly to the Manufacturer.

Power Transmission Equipment

MORSE CHAIN CO., Division of Borg-Warner Corporation, Ithaca, N. Y. Catalogue containing complete data, including prices, on silent chain drives, couplings, and roller chain drives. Stock silent chain drives are listed by horsepower, covering a range of from 1/2 to 50 horsepower for eleven different pitches. Considerable information of value to the designer is given, including data for the design of chain drives, charts for selecting a Morse chain type coupling suitable for various horsepowers and speeds, etc.

Electric Motors

GENERAL ELECTRIC CO., Schenectady, N. Y. Catalogues GEA-1326B, 1341C, 1366A, 1538A, 1619B, and 2345, illustrating and describing, respectively, totally enclosed, fan-cooled, induction motors; explosion-proof, totally enclosed, fan-cooled, induction motors; totally enclosed hoist motors; Type K totally enclosed induction motors; splash-proof induction motors; and general-purpose, squirrel-cage, induction motors.

Small Tools

MCCROSKY TOOL CORPORATION, 1340-70 Main St., Meadville, Pa. Bulletin 15-F, containing line illustrations showing forty different designs of line-reaming, counterboring, spot-facing, chamfering, and similar tools, all equipped with serrated blades and the McCrosky patented "Jack-Lock" wedge. Tool engineers should find these designs of value in suggesting methods of combining operations and reducing costs.

Speed Reducers

D. O. JAMES MFG. CO., 1114 W. Monroe St., Chicago, Ill. Bulletin 11, descriptive of right-angle spiral bevel gear speed reducers with ratios from 1 to 1 up to 6 to 1. Bulletin 16, descriptive of right-angle spiral bevel continuous-tooth herringbone speed reducers with ratios from 6 to 1 up to 45 to 1. Catalogue 141, on right-angle spiral bevel spur gear speed reducers with ratios from 8 to 1 up to 1200 to 1.

Tool-Room Lathes

LODGE & SHIPLEY MACHINE TOOL CO., Cincinnati, Ohio. Catalogue illustrating and describing in detail the Lodge & Shipley 12-, 14- and 16-inch tool-room lathes. The various special features of design of these lathes are described, together with the attachments, and complete specifications are included. Tables of standard and special thread, lead and feed ranges and of metric leads and feeds are given. The catalogue also contains data on individual motor drives and tool-room attachments.

V-Belt Drives

ROCKWOOD MFG. CO., Division of General Fibre Products, Inc., 1801 English Ave., Indianapolis, Ind. Data Books 782 and 783, designed to assist the user of V-belt drives to easily select a suitable drive for a given purpose. Data Book 782 covers multiple-groove drives and Data Book 783 covers fractional-horsepower single-groove drives, the range in both cases being from fractional to 500 horsepower.

Drilling Machines

MOTCH & MERRYWEATHER MACHINERY CO., Cleveland, Ohio. Catalogue covering the principal types of drilling machines handled by this company, including boring, drilling and tapping machines; hand-feed drilling machines; motor-spindle machines; radial drilling machines; and the "Hole Hog" line of multiple drilling, boring, reaming, counterboring, tapping, lapping, and special machinery.

Thread-Cutting Machinery and Die-Heads

LANDIS MACHINE CO., Waynesboro, Pa. Operator's Instruction Book, containing detailed data covering the care and operation of Landis stationary pipe die-heads and pipe threading and cutting machines. The book also contains complete information on grinding and setting the chasers for these die-heads and machines.

Steel for Molds

CARPENTER STEEL CO., Reading, Pa. Publication entitled "Mold Steel for Molded Plastics," containing an informative treatise on these steels. It deals with their physical properties, machining and heat-treatment, and covers in detail a number of different Carpenter steels with full information on their use and application.

Electric Equipment

FAIRBANKS, MORSE & CO., 900 S. Wabash Ave., Chicago, Ill. Bulletin E-100B, entitled "Electric Machinery Catechism," a publication designed to answer the questions likely to arise in the minds of those who use electrical equipment and do not have an extensive formal knowledge of electrical terminology or phenomena.

Dust Counting Equipment

BAUSCH & LOMB OPTICAL CO., 619 St. Paul St., Rochester, N. Y. Circular descriptive of the Bausch & Lomb dust counter, which has been developed to enable dust concentration to be definitely determined in order to protect workers against ailments caused by the inhalation of dust.

Aluminum and Aluminum Products

ALUMINUM CO. OF AMERICA, Pittsburgh, Pa. Booklet entitled "Finishes for Aluminum," covering mechanical finishes, chemical dip finishes, electrolytic oxide finishes, electroplating, and paint, lacquer, and enamel finishes.

Indicating, Recording, and Controlling Equipment

BROWN INSTRUMENT CO., 4485 Wayne Ave., Philadelphia, Pa. Catalogue 8901, covering the complete line of Brown Air-O-Line air-operated controllers for the control of temperature, pressure, flow, and liquid level.

Lubricants

E. F. HOUGHTON & Co., Philadelphia, Pa. Bulletin entitled "Research Illustrated," devoted to lubrication problems and equipment. The publication gives specific information on methods of lubricating different machine parts, such as plain bearings, ball bearings, gears, etc.

Electric Dip Brazing Pots

MIAC PRODUCTS CO., Fort Wayne, Ind. Bulletin B, describing the special features of a new electric silver solder pot for dip-soldering fine wires and small parts. The company is also distributing an instruction chart describing the operation of this equipment.

Tap Chamfering Fixtures

DETROIT TAP & TOOL CO., Detroit, Mich. Bulletin describing the features and method of operation of the Detroit tap chamfering fixture, which is designed for all sizes of taps up to 1 1/4 inches, inclusive, with any number of flutes and any length shank.

Heat-Treating Furnaces

AMERICAN GAS FURNACE CO., Elizabeth, N. J. Loose-leaf circular illustrating and describing an improved type of high-speed furnace for hardening high-speed steel. Loose-leaf bulletin descriptive of improved oven furnaces for heat-treating.

Variable-Speed Transmission

LENNEY MACHINE & MFG. CO., Warren, Ohio. Catalogue illustrating and describing the principle of operation, speed regulation, speed control, and special features of the new Lenney variable-speed transmission.

Electric Welding Machines

ELECTRIC CONTROLLER & MFG. CO., 2700 E. 79th St., Cleveland, Ohio. Booklet containing a reprint of an article on the "Theory and Application of Resistance Welding," recently published in the *Welding Engineer*.

Welding Equipment

LINCOLN ELECTRIC CO., Cleveland, Ohio. Application Sheet No. 51, giving definite information to the designer on the application of the welding process in machine design, with especial reference to miscellaneous small parts.

Hydraulic Riveters

HANNIFIN MFG. CO., 621-631 S. Kolmar Ave., Chicago, Ill. Bulletin 32, describing the exclusive features, advantages, operating cycle, and safety features of the Hannifin "Hy-Power" hydraulic riveters, designed for high-speed noiseless operation.

Roller Bearings

TIMKEN ROLLER BEARING CO., Canton, Ohio. Booklet entitled "The Answer to Rolling Mill Bearing Problems," briefly explaining the reasons why Timken bearings have achieved their present wide use in the rolling mill industry.

Micrometer Dial Gages

B. C. AMES CO., Waltham, Mass. Catalogue describing the exclusive features of the Ames "Shockless" micrometer gages, which are made in four different sizes with various ranges. Price lists are included.

Cleaning Methods

DETROIT REX PRODUCTS CO., Detroit, Mich. Booklet entitled "Scientific Metal Cleaning." Folder illustrating and describing Detrex degreasers. Leaflet describing method of cleaning before rustproofing.

Operating Valves

ROSS OPERATING VALVE CO., Detroit, Mich. Catalogue 36, covering the line of operating valves made by this company for hand, foot, mechanical, and electrical control of machines and equipment.

Pre-Finished Metals

AMERICAN NICKELOID CO., Peru, Ill. Circular entitled "The Key to More Sales and Bigger Profits," containing information on the line of bonded or pre-finished metals made by this company.

Inclinable Presses

J. L. LUCAS & SON, INC., 3 Fox St., Bridgeport, Conn. Circular illustrating and describing the Loshbough-Jordan open-back inclinable presses which are being marketed by this company.

Die-Casting Machines

MADISON-KIPP CORPORATION, 203 Waubesa St., Madison, Wis. Folder L-3700, covering Madison-Kipp lubricators and oil systems, die-casting service, die-casting machines and dies, and air-operated tools.

Air Compressors

WORTHINGTON PUMP & MACHINERY CORPORATION, Harrison, N. J. Circular W-621-B1A, descriptive of Worthington single direct-acting air-cooled air compressors.

Power Transmission Equipment

AMERICAN CHAIN CO., INC., Bridgeport, Conn. Catalogue 365, covering welded chain and attachments. Catalogue 366, dealing with weldless chains and attachments.

Portable Electric Tools

WODACK ELECTRIC TOOL CORPORATION, 4627 W. Huron St., Chicago, Ill. Bulletin 361, descriptive of the Wodack "Do-All," a combination electric hammer and drill.

Heat-Treating Equipment

W. S. ROCKWELL CO., 50 Church St., New York City. Catalogue 361, illustrating and briefly describing Rockwell forging and heating furnaces.

Electric Trucks

ELWELL-PARKER ELECTRIC CO., Cleveland, Ohio. Bulletin descriptive of the "EQ" low-lift platform trucks which have a capacity of 3000 pounds.

Oil Seals

GARLOCK PACKING CO., Palmyra, N. Y. Catalogue describing the Garlock "Klozure" oil seal, and giving complete list of standard sizes.

Nickel Alloy Steel

INTERNATIONAL NICKEL CO., INC., 67 Wall St., New York City. Bulletin U-1, containing information on automotive uses of nickel alloy steels.

Portable Cranes

LEWIS-SHEPARD CO., 175 Walnut St., Watertown, Mass. Folder 506, covering this company's line of hand and electric portable cranes.

Drilling Machines

AVEY DRILLING MACHINE CO., Cincinnati, Ohio. Bulletin entitled "Aveymatic Means More Than Automatic."

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Brown & Sharpe Cutter- and Tool-Grinding Machine

All table and wheel controls are located within easy reach of the operator from one position, on a cutter- and tool-grinding machine recently brought out by the Brown & Sharpe Mfg. Co., Providence, R. I. This machine accommodates all the usual types and sizes of cutters. The low fixed height permits the operator to easily see the grinding wheel in contact with the work when at the natural operating position in front of the machine. The table and spindle movements can be made smoothly, easily, and accurately when either light or heavy work is being ground.

Work or cutters 10 inches in diameter and 20 inches long can be held between centers, but the largest diameter that can be ground on centers is 6 inches. The maximum longitudinal table travel controlled by the handwheel is 18 inches. A 4-inch table reciprocating movement by means of a hand-lever is available at any position within the 18-inch travel of the table.

A heavy single-piece base casting supports the sliding table and the wheel-spindle column. The sliding table on which the swivel table is mounted can be traversed by hand at either a fast or a slow rate, the slow rate being 11/16 inch and the fast rate 6 1/2 inches per revolution of the handwheel. A graduated arc at the front of the swivel table reads to degrees and a scale at the end reads up to a 3-inch taper per foot. The center-head and footstock are clamped to the swivel table and drawn into alignment by bolts placed at an angle to the table surface. The center-head is equipped with a clearance setting gage.

The wheel-spindle column has a transverse movement of 7 inches which is controlled by a handwheel provided with 0.001-

Fig. 1. Brown & Sharpe Cutter- and Tool-grinding Machine Designed for Convenience of Operation

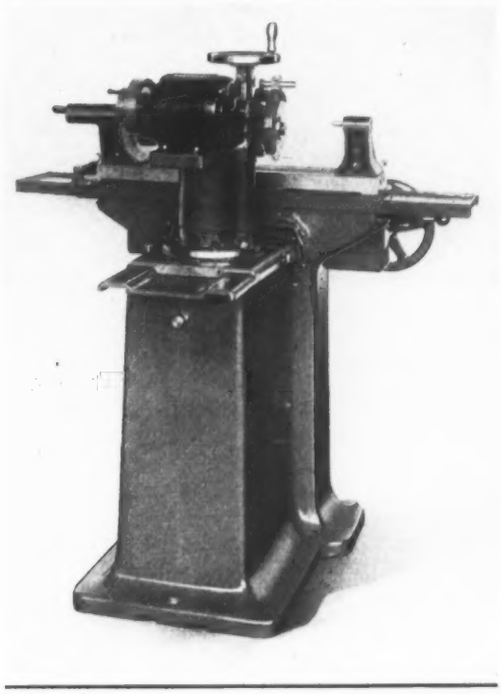
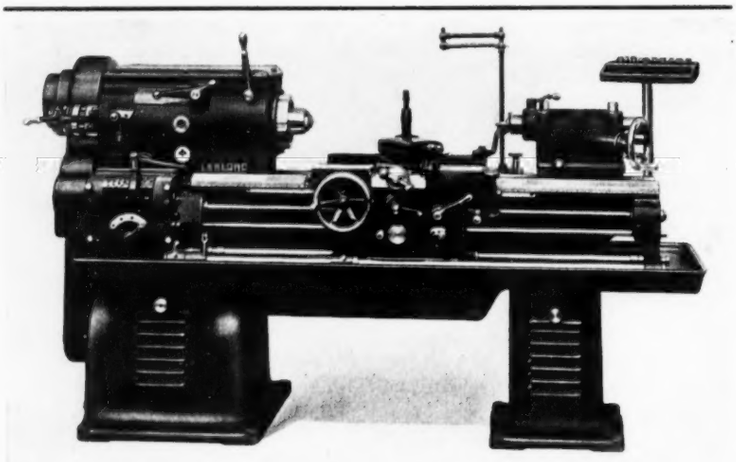


Fig. 2. Rear View of Cutter- and Tool-grinding Machine Showing Wheel-spindle Column

inch graduations. This column swivels 90 degrees either side of the zero line and has a scale reading to degrees. Spring shoes maintain the column alignment, and a vertical setting clamp is provided. The 5 1/2-inch vertical adjustment is controlled by a handwheel graduated to 0.001 inch.

A constant-speed dustproof motor drives the cartridge type spindle by a V-belt. Spring shoes automatically maintain adjustment of the wheel-spindle boxes. Two wheel speeds are available —3760 and 4380 revolutions per minute. The machine is equipped with a universal head, cutterbars, tool-rests, wheel sleeves, etc. Numerous attachments are available for the economical handling of various kinds of work. Among these attachments are index-centers, bushings for Nos. 10, 20, and 30 milling machine standard taper shanks, No. 1 adjustable vise, and taper-holding and face-mill grinding attachments.



LeBlond Precision Tool-room Lathe Designed for Rapid Operation

Le Blond Tool-Room Lathe

A tool-room lathe designed to handle tool and fixture work with the convenience and economy of regular production lathes has been brought out by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio. One of the features of this lathe is the convenient arrangement of the operating levers, which have been reduced to the minimum number for efficient operation.

The headstock spindle is supported at short intervals by three anti-friction bearings, preloaded precision taper roller bearings being used at the front and center supports, with a roller bearing at the end to provide the floating action required to compensate for the slight variations resulting from temperature changes. The gears slide on splined shafts, and the final drive is through a wide helical-face gear. This construction gives a quiet smooth running head. The gear train for the twelve speed changes and the compound gearing for the feed and reverse are built into the headstock.

The improved and simplified apron is of double-wall box type construction with one control for both longitudinal and cross movements and has "one shot" lubrication. The extra long tailstock spindle has a full-length bearing in the tailstock, even when well extended. The handwheel for adjusting the tailstock is located at an angle to facilitate operation. Automatic stops are provided for controlling the feed in both directions. The lathe bed has a compensating front-way construction which gives additional bearing surface.

There are fifty-six quick changes of feed which cover a range of from 0.0013 to 0.166 inch, and a thread cutting range from 1 1/2 to 184 threads per inch. A multi-disk driving clutch and brake is used and the drive is by multi V-belts. A separate drive is employed for the lead-screw and the feed-rod. Both ends of the lead-screw run in anti-friction thrust bearings. Automatic lubrication with filtered oil and a sight-feed indicator assure adequate lubrication at all times. The new standard spindle nose designed for rapid, accurate, and positive mounting of chucks, faceplates, and fixtures is used. An improved taper attachment is provided.

De-Ion Non-Reversing Line Starters

A line of De-ion non-reversing line starters recently announced by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is available in four sizes ranging from 25 to 150 amperes. These starters are intended for across-the-line starting of squirrel-cage induction motors and for use as primary switches for wound-rotor induction motors. Typical applications include machine tools, textile machinery, pumps, fans, and similar equipment on which a control is desired from a push-button or other pilot device, with complete protection to the operator, the motor, and the machine.

An arc quencher confines, divides, and extinguishes the arc almost instantly without flash or scattering of the flame. This insures not only a high degree of safety, but also practically unlimited life of the arc box and contacts. Motor protection is provided by a bi-metal thermal overload relay.

The contactor and overload relay are mounted on a steel panel which has no wiring on the back, thus making these line starters especially suitable for built-in applications. All parts and terminals are accessible from the front.

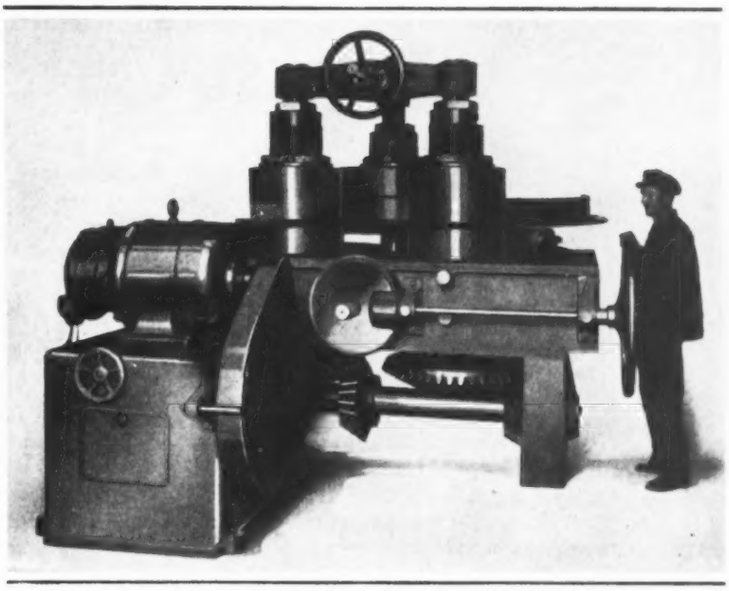
"Schatz-Herkules" Angle-Iron Bending Rolls

Angle-irons up to 8 by 8 by 1 inch, I-beams and channel-irons up to 18 inches, flat bars up to 8 by 1 inch, and other structural shapes in proportion can be bent by the "Schatz-Herkules" size BO-34 horizontal bending rolls here shown, which are being placed on the market by the Schatz Mfg. Co., Poughkeepsie, N. Y. An important feature of this machine is that various shapes can be handled without the necessity of interchanging the rolls. Furthermore, the patented roll design insures the accurate rolling of angle-irons with the legs in or out, etc., without twisting, so that the work comes out of the machine round and true.

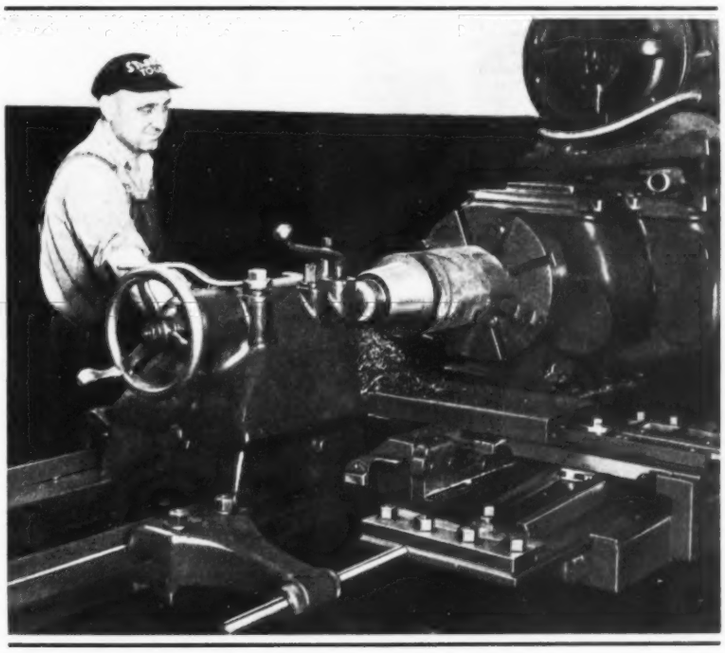
Standard machines of this line are built in five sizes for rolling up to 3-, 4-, 5-, 6-, and 8-inch angle-irons. Normally two of the rolls are driven, but all three rolls can be positively driven when required. This enables the machine to bend to diameters smaller than usual.

There are two operating speeds, the higher being about 32 feet per minute, and the lower 16 feet per minute. All gears that must withstand high strains are made of steel with cut teeth. High-speed shafts run in ball bearings. A 40-horsepower motor of the reversible type is required to drive the largest machine, which is the one shown in the illustration. This machine weighs approximately 36,500 pounds.

Three machines of smaller size than those mentioned are also available for rolling angle-irons below the 3-inch size.



"Schatz-Herkules" Bending Machine which Handles Stock of Various Shapes without the Necessity of Changing Rolls



Threading a Tapered Oil Tool Joint on a Monarch 24-inch Lathe Equipped with New Taper Attachment

Taper Attachment for Monarch Lathes

A taper attachment equipped with ball bearings to eliminate friction and wear has been brought out by the Monarch Machine Tool Co., Sidney, Ohio. Twenty permanent oil-seal ball bearings with eccentric stud mountings which provide for adjustment are incorporated in the design.

The attachment is made in three capacities, covering the range of lathe sizes from 12 to 36 inches. The smallest size, for 12- and 14-inch lathes, will turn a 6 1/2-inch taper per foot for a length of 12 inches at one setting, while the largest size, for 20- to 36-inch lathes, will turn a 6 1/2-inch taper per foot for a length of 24 inches at one setting.

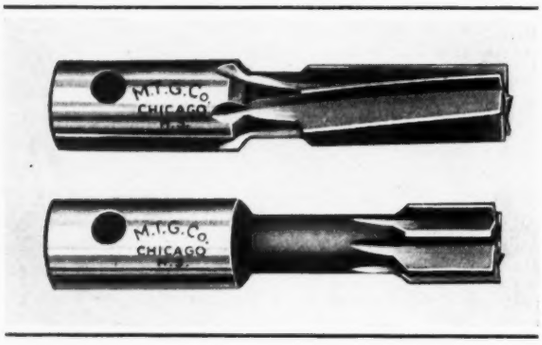
This attachment has been designed to turn or bore accurate,

smooth tapers under all conditions, and to take heavy cuts, even on steep tapers. On a 20-inch Monarch lathe, for example, cuts 1 1/8 inches deep can be taken in turning a 6 1/2-inch taper per foot in S A E 1035 steel with a feed of 0.090 inch per revolution.

La Salle Screw Machine Reamers

Screw machine reamers to fit all standard floating holders are now being manufactured by the Machinists Tool Grinding Co., 3038-40 Van Buren St., Chicago, Ill., in sizes from 0.1581 to 0.817 inch in diameter. The number of flutes ranges from four to eight. Standard reamer blanks of high-speed steel are carried in stock 90 per cent complete, ready to be ground to any specified diameter. When desired, hardened blanks with ground flutes and shanks can be supplied for grinding to the finished size by the customer.

These reamers are made with left-hand spiral flutes having an angle of 7 degrees. The reamers can be furnished with the lands backed off and relieved or in the rose type without relief. The reamers are manufactured in but five shank sizes, which enables them to be produced economically. Accuracy and long life are other advantages claimed for this new line of screw machine reamers.



Screw Machine Reamers Made by the Machinists Tool Grinding Co., with or without Relief, to Fit All Standard Floating Holders

Graham Variable-Speed Transmission

Any desired output speed from one-half the motor speed down to zero, and, in addition, rotation in the reverse direction can be obtained through a single turn of the control wheel on a new type of variable-speed transmission placed on the market by Graham Transmissions, Springfield, Vt. This unit is built by the Fellows Gear Shaper Co. It is designed on the principle of using rollers to effect speed reduction. The unit is self-contained, runs in oil, and has only five major parts.

The power is commonly taken from a constant-speed motor, the shaft of which is connected to carrier *A*, Fig. 2, which, therefore, rotates at the motor speed. The carrier supports three tapered rollers *B* which are kept in close contact under pressure against a non-rotating ring *C*. The rollers, therefore, must turn at the motor speed times the ratio of the ring and the roller diameters at their point of contact with the ring.

The three rollers carry planet pinions which mesh with internal gear *D*, the latter being connected to the output end of the unit and thus providing a step-down ratio combined with the speed variation. Speed variation is obtained by moving ring *C* along the tapered rollers. Gear-tooth contact is quiet in this transmission because the internal gear is made from a non-metallic material. The transmission operates equally well in either direction of rotation. It can also be driven from the output end when a slow-running lineshaft must supply power at variable speeds to a high-speed machine.

The Graham transmission is obtainable in several combinations. For example, the motor can be built in, as shown in the illustrations, or it can be connected to the transmission by means of a flexible coupling, in which case the motor and unit are mounted on a common bedplate. The transmission may also be driven from a lineshaft or other source of power, in which case the motor is omitted and a high-speed shaft extension is provided.

A geared head can be incorporated at the output end without appreciably increasing the over-all length. The geared head will provide a reduction as great as 7 to 1 or a step-up as high as 1 to 4. With the latter arrangement, a speed as high as twice the motor speed can be obtained. With the reduction gearing, full motor power can be developed at a top speed of 60 revolutions per minute, a feature that is especially advantageous for low-speed, high-torque drives.

Since changes throughout the entire speed range are effected with only a few pounds pressure applied to the control wheel, the

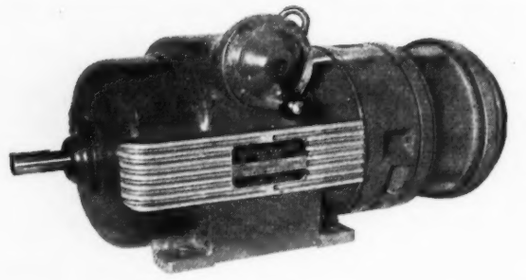


Fig. 1. Graham Transmission which Provides Any Speed from One-half the Motor Speed down to Zero, and Also Reverse Rotation

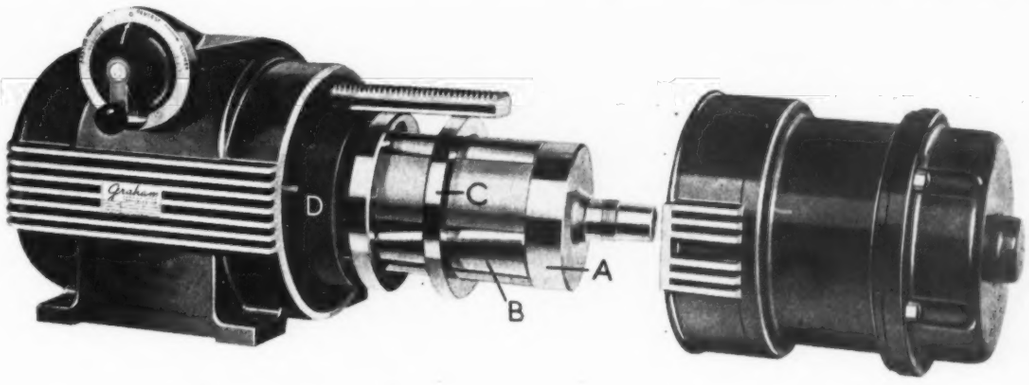


Fig. 2. Graham Transmission Dismantled to Show the Details of Construction

transmission is especially adapted to remote or automatic control. This may be effected by means of a pressure or tension device, cam, pilot motor, Selsyn apparatus, or other method. A uniform jogging control has been devised which is particularly desirable for cyclic operations when the drive shaft is to be rotated at a pre-selected speed, suddenly stopped, and restarted. The same device is adapted to "inching" operations of various kinds. Control of the unit is effected without stopping the motor or disturbing the pre-set speed, the driven shaft being brought back automatically to the operating speed for which the unit has been set, after inching, reloading, or similar intervening operations.

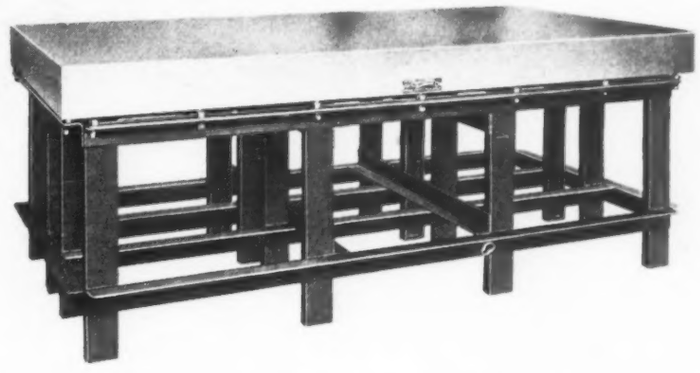
This transmission is available at present in three standard sizes up to 7 1/2 horsepower, and in two speed ranges—normal and extreme. The normal range (4 to 1) is especially suited for constant-horsepower applications, whereas the extreme range unit provides speeds down to zero and in the reverse direction.

Surface Plates with Steel Supporting Frames

Improved surface plates for use in the accurate lay-out, assembly, and inspection of work are being manufactured by the Challenge Machinery Co., Grand Haven, Mich., in standard sizes from 12 by 18 inches up to 48 by 96 inches. These semi-steel plates are planer-finished smooth and square. They are heavily ribbed underneath to prevent sagging. The all-steel arc-welded frame is provided with a large number of leveling screws. These plates can also be supplied without the supporting frame.

Detrex Degreasing Equipment

Several new types of degreasers have recently been built by the Detroit Rex Products Co., 13,005 Hillview Ave., Detroit, Mich., to suit specific applications. One of these machines, which has been designed to handle poppet valves, small flat sheets, etc., is provided with a conveyor that has work-holding racks at intervals. The conveyor lowers the work into the solvent vapors and passes through pressure sprays of hot clean solvent. After making a horizontal turn around a traction wheel, the conveyor brings the work back through the vapors. The work is then raised and passed out of the machine at the same end and at the same height as it entered. The rated cleaning capacity of this machine is approximately 6500 small parts an hour at a conveyor speed of 10 1/2 feet a minute. The unit measures 20 feet long by 5 feet wide, by 9 feet high.



Surface Plate Measuring 4 by 6 Feet which has a Supporting Frame of Arc-welded Construction

Another automatic vapor type degreaser has been developed for cleaning heavy-gage metal parts. This machine is equipped with a two-strand cross-rod type of conveyor having a variable-speed drive. Fixtures suspended from this conveyor on 30-inch centers carry work baskets through the degreaser.

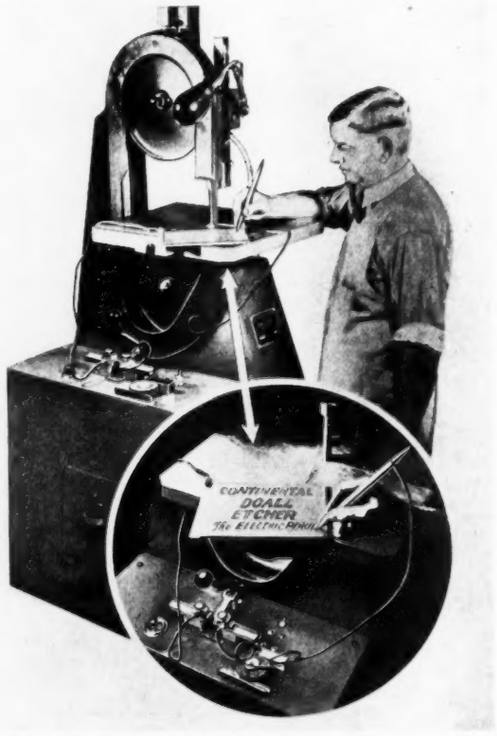
The work is received from a gravity roller conveyor, loaded in grill type metal baskets having perforated plate separators. These work baskets are automatically lifted from the conveyor fixtures and carried through the degreasing machine where they are subjected to a solvent vapor. At the opposite end of the machine, the work baskets are automatically transferred to another gravity roller conveyor.

Large stampings and deep-drawn parts are handled by means of a three-dip degreaser, in which the cycle of cleaning operations consists of, first, immersion in boiling solvent; second, immersion in solvent distillate rinse; and third, immersion in pure solvent vapors. In this machine also the work is conveyed by means of baskets suspended from conveyor cross-rods. The work is delivered dry, ready for a subsequent finishing operation.

"Do-All" Etching Pencil

An electric pencil known as the "Do-All" etcher has just been placed on the market by Continental Machine Specialties, Inc., 1301 Washington Ave., S., Minneapolis, Minn. Writing on steel with this electric pencil is a process of arc welding in which the tip of the pencil vibrates to permit the miniature arc to be interrupted and produce the etching effect. An entirely new principle is used to accomplish the vibration of the point of the etching pencil. A special coil in the pencil is attached directly to the writing point, which is made of pure tungsten to resist heat and wear.

The pencil is operated from the transformer built into the "Do-All" sawing, filing, and polishing machine made by this company, and is now included with this machine. The principal function of the transformer is to weld or braze the metal-cutting band saws used in the machine. The low voltage and high amperage of the brazing transformer is especially suited to the requirements of the electric pencil. The current is regulated with a three-heat switch—shown in the lower illustration—to give any desired degree of intensity for the etching arc. The illustration shows how the etching operation is done.



"Do-All" Machine Equipped with Etching Pencil

Truck Casters with Hyatt Roller Bearings

The Bond Foundry & Machine Co., Manheim, Pa., has placed on the market a line of anti-friction truck casters that are provided with Hyatt roller bearings in the center of the wheels. Washers pressed into the ends of the hubs hold the bearings in place. The rollers run on a hardened and ground steel sleeve which is held rigidly in place by means of a threaded axle bolt.

These casters are regularly made in diameters from 2 1/2 to 14 inches, and in widths from 1 to 3 1/2 inches. The swivel above the wheel is provided with two ball races to insure easy movement in the horizontal plane.

Baush Deep-Hole Boring Machine

A precision cylinder boring machine has been brought out by the Baush Machine Tool Co., Springfield, Mass. This machine has a heavy steel base and a rigid cast-iron column which provide a solid foundation for the fixture and head, respectively. The feed is obtained by a hydraulic cylinder centered directly over the line of the cylinder bores.

Four "catspaws" in the boring-bar tube support the bar directly behind the revolving single-point tool during the entire downward feeding stroke, making possible a high degree of accuracy. The "catspaws" consist of four non-revolving expanding and contracting supports which are located just back of the cutting tool. They automatically expand against the freshly cut wall of the bore while the tool is still close to the guiding bushing. These

supports provide a rigid guide for the fly cutter.

The "catspaws" make it possible to use a tool having a wider face than those previously employed for deep boring. A wide-face tool permits a moderate cutting speed without sacrificing production, since a high feed can be used without affecting the quality of the finish. A medium cutting speed and minimum vibration make it possible to use hard tungsten-carbide tools to advantage. It has been found that a boring feed of 9 inches per minute will give a finish suitable for honing with a 500-grit stone.

The machine can be furnished with any number of spindles for boring holes 2 to 9 inches in diameter. A typical automobile cylinder block bored on this machine and subjected to seventy-two measurements, six in each bore for out-of-roundness and six in each bore for taper, showed that the greatest error did not exceed 0.0003 inch.

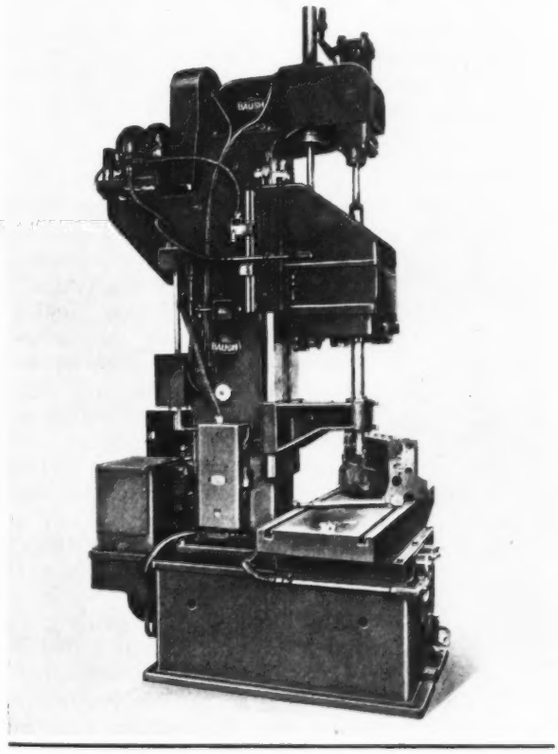
Fosdick Combination Drilling Machine and Jig Borer

A machine that meets the average requirements of a jig borer and that can also be used in a production department to produce duplicate parts when the quantity is not large enough to warrant the expense of jigs and fixtures has been placed on the market by the Fosdick Machine Tool Co., Cincinnati, Ohio. The design of this machine is sufficiently flexible to enable the user to operate it as an efficient drilling machine and also as an accurate jig borer.

The bearing ways for the bed, slide, and table consist of one vee and one flat way. The slide is equipped with two tapered gibs and hold-down clamps to prevent any side or lifting motion, and the table is provided with hold-down clamps. These units can be locked solidly to each other by means of clamps directly in front of the operator.

There are two large handwheels at the front of the machine, one for moving the table in and out, and the other for traversing the table crosswise. There are two operating positions and a neutral position for each handwheel. One of the operating positions gives a high-speed traverse at the rate of 1/2 inch for each turn of the handwheel, while the other gives 0.050 inch of traverse for each handwheel turn. The handwheels are placed in the neutral position to prevent them from moving after the table has been set for an operation. The two table speeds are obtained through gear-boxes on the bed and slide which are equipped with hardened gears and anti-friction bearings.

Accurate positioning of the table is made possible by means of an indicator that reads to



Baush Deep-hole Boring Machine with Special Tool-supporting Arrangement

Fig. 1. Fosdick Combination Drilling Machine and Jig Boring Machine

0.0001 inch, measuring rods, and a micrometer that reads to 0.0001 inch. The ways and all revolving parts of the table and slide are lubricated from a central location in a manner that insures adequate lubrication at all times.

The drive to the spindle is through a gear-box which provides twelve spindle speeds from 60 to 1500 revolutions per minute, and nine feeds from 0.0025 to 0.020 inch. All changes are obtained by means of one lever. Forward and reverse rotation of the spindle are obtained by means of a lever which operates a multiple disk clutch. The spindle runs in precision bearings which are preloaded, and the spindle nose is equipped with interchangeable collets. There is a direct-reading depth gage for drilling operations, and a measuring device that insures accurate spot-facing or counterboring. The distance from the spindle to the column is 15 inches.

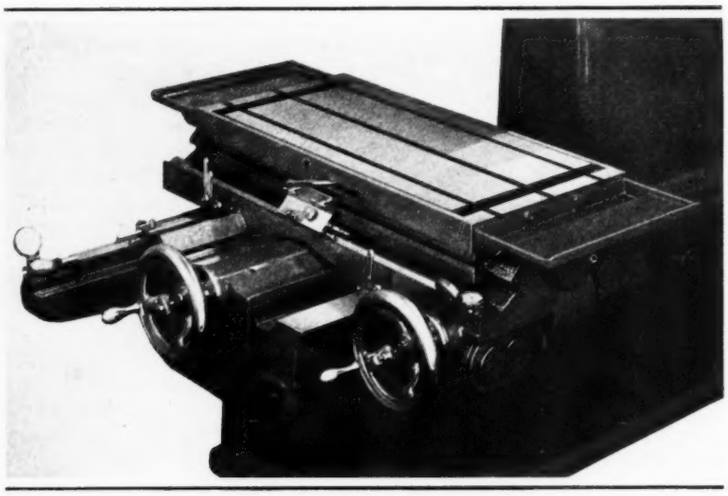
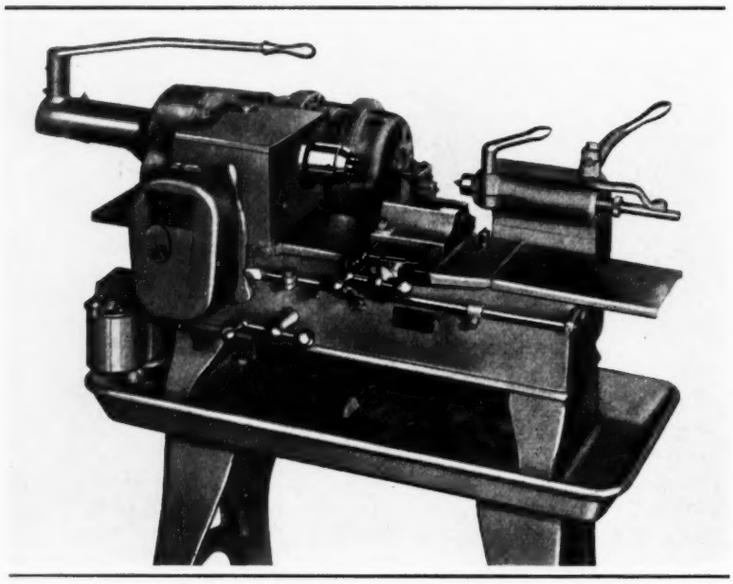


Fig. 2. Close-up View of the Table, Slide, and Bed, Showing the Accurate Measuring Means

High-Speed Headstock for Porter-Cable Manufacturing Lathe

A high-speed headstock designed for the rapid turning, facing, and boring of small precision parts, such as valves, pistons, pulleys and commutators, has been brought out by the Porter-Cable Machine Co., Syracuse, N. Y., for the 9-inch manufacturing lathe built by that company. This equipment is especially adapted for second-operation work with tungsten-carbide, Stellite, or diamond tools, and will accommodate a wide range of multiple tooling on both the front carriage and the facing attachment.



Porter-Cable Manufacturing Lathe Equipped with High-speed Headstock

The spindle is mounted on high-speed, preloaded ball bearings, provided with force lubrication. The rear bearing is allowed to float and thus compensate for variations due to temperature changes. Multiple V-belts drive the spindle unit directly from the motor, which is mounted on an adjustable bracket. The motor is insulated from metal-to-metal contact by a vulcanized rubber mounting, which eliminates the transmission of motor vibration to the spindle.

Air cylinders or mechanically operated chuck closing devices can be used with the hollow spindle. Various spindle speeds up to 3600 revolutions per minute can be obtained by the use of different size motor pulleys. The spindle is operated directly from the motor without a clutch, and is started and stopped by a switch. A reversing type switch or brake type motor can be used as desired.

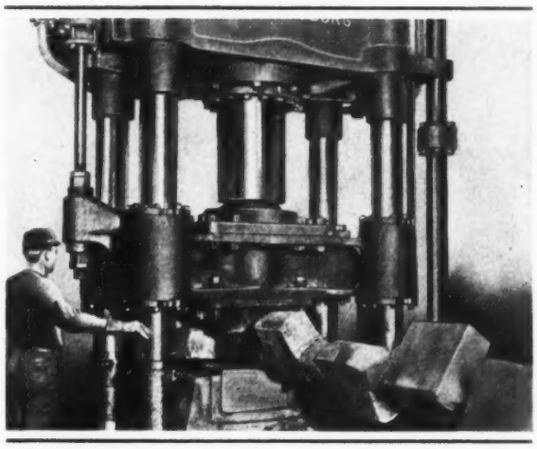
Pick-off gears driven by a V-belt from the spindle provide feeds from 0.0005 to 0.010 inch. The back-facing attachment may be used in conjunction with the front carriage if desired. The swing is 9 inches, and the distance between centers, 20 inches.

Chambersburg High-Speed Forging Press

Two styles of high-speed steam-hydraulic forging presses have been added to the line of the Chambersburg Engineering Co., Chambersburg, Pa. These presses are manufactured and sold by this company through an arrangement with the United Engineering & Foundry Co., Pittsburgh, Pa., and under Davy Bros., Ltd. patents. They are designed to forge heavy work quickly to a close degree of accuracy. The two general styles, namely, the single-frame and the four-column models, embody the same principles and have the same applications, the only difference being in the capacity and physical features. The essential elements of the press are the steam intensifier and the water reservoir or prefiller tank.

Close control of the intensifier or forging stroke is obtained by a gear attached to the intensifier. A slow movement of the hand-lever results in a correspondingly slow squeeze of the press. Stopping the movement of the hand-lever arrests the action of the press. This gives the operator complete control of the machine, and is a particularly valuable feature in cutting off or when a bending operation is being performed.

The single-frame press, built in 150-ton and 500-ton sizes, is particularly suited for railroad and other repair shops where a large variety of bending, forming, and forging operations are performed. The four-column model is built as a single-cylinder press up to the 1500-ton size and as a duplex ram press from 2000 tons capacity upward.



Chambersburg Four-column Steam-hydraulic Press Equipped for Forging Heavy Crankshaft

Norton Tool-Grinding Wheel

A wheel for tool grinding designated as the B-E bond has been developed by the Norton Co., Worcester, Mass. This wheel is basically an improved form of the B bond wheel previously patented by the same company. The same features that make this wheel valuable for tool grinding also adapt it for surface grinding, centerless grinding, and other work.

The B bond was originally developed to overcome certain undesirable qualities found in ordinary types of vitrified bonds, namely, the chemical reactions that occur during burning in the kiln and the physical strains that develop during subsequent cooling—two things that affect the internal arrangement of the grains in a wheel and the strength uniformity of the bond. The B-E bond overcomes these objections to a still greater degree, resulting in a wheel of exceptionally uniform and stable composition. When used with Alundum abrasive, this bond gives a wheel of a blue-gray color, while with 38 Alundum, it gives the same pure white color characteristic of the B bond wheels. Extensive tests have shown B-E bond wheels to have a cool and free cutting action, and long life as well.

Norton B-E Bond Grinding Wheels Developed for Cooler and Faster Cutting

Portable Machine for Testing Spot Welds

A 10,000-pound hydraulic tension testing machine with a direct-connected 1/4-horsepower motor has been developed by the Baldwin-Southwark Corporation, Philadelphia, Pa., for the Edward G. Budd Mfg. Co., manufacturer of streamline trains and automobile bodies.

This machine is designed for portable use where constant testing of the strength of spot welds is necessary. It is provided with a round base 18 inches in diameter to facilitate rolling it from place to place. A hoisting hook to permit using a crane is also provided. The testing machine has an over-all height of 70 inches and weighs approximately 800 pounds.

Harnischfeger Automatic Welding Machine

An automatic welding machine that is claimed to be the first of its kind to use standard coated rods has been developed by the Harnischfeger Corporation, 4536 W. National Ave., Milwaukee, Wis., for arc welding in all kinds of metal fabrication work. This Robot welding machine is operated by remote control and is designed to place arc welding on a mass production basis. The elimination of the hand-operated electrode-holder makes it possible to use a higher current with welding heats as much as 60 per cent higher, thus increasing the welding speed. This machine can be used on flat work of any length and on circular pieces. Any shape can be welded by employing the pantograph attachment. It is adaptable for use on lathes, planers, rotating tables, and boring mills, with wall cranes, and for welding long girders.

Up to fifty standard welding rods are loaded in a magazine and then fed automatically to the welding position. As one electrode is consumed the butt is ejected and a new, full-length rod is fed into place. This renewing operation is accomplished so quickly that no break appears in the welded bead. The arc length is automatically regulated at a constant point during the welding operation. Even though the working surface is irregular, there is no apparent variation in the penetration or the appearance of the bead.

Porter-Cable Electric Quick-Return for Milling Machines

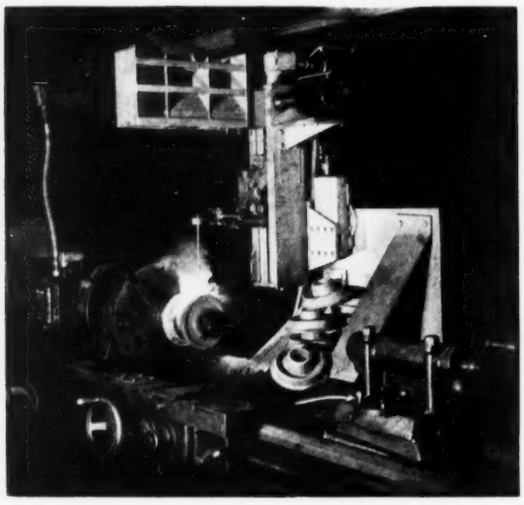
An electric quick-return for use on production milling machines built in the years from 1912 to 1921, and on milling machines built since that time which have no quick-return feature, has been brought out by the Porter-Cable Machine Co., 100 Wolf St., Syracuse, N. Y. This quick-return attachment is similar in design and operation to the one made by the same company for operating a lathe carriage, which was described in April, 1935, MACHINERY, page 494.

Faster table travel and less fatigue of the operator are advantages obtained by the use of the attachment. Index fixtures may be located on either end of the machine and the quick-return movement used to feed quickly from one fixture to the other. In cutting several keyways on a long shaft, the table can be moved quickly from one keyway position to another.

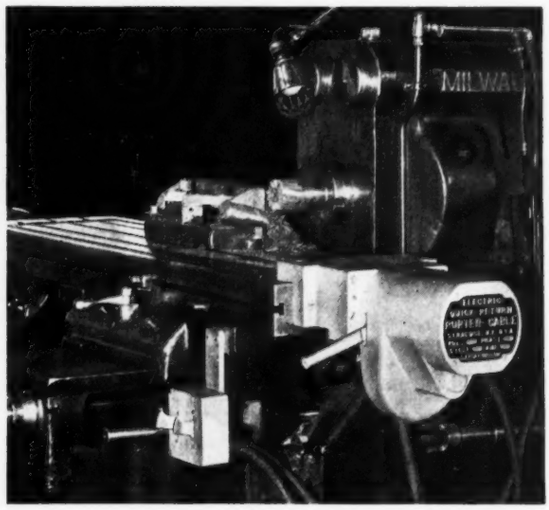
The electric quick-return can be easily mounted on the milling machine by the use of special brackets. The drive is mounted on the feed-screw nut. The table can also be operated manually by means of the hand-crank at the end opposite the quick return unit. The device cannot be used on rack type machines.

A 220-volt, 60-cycle, three-phase alternating-current motor having a speed of 1800 revolutions per minute is ordinarily employed, but a motor adapted for operation on other voltages can be furnished. The special reversing type motor is totally enclosed in an aluminum housing and is rated at 1/2 horsepower. The torque winding of the motor permits a 300 per cent overload.

The drive is through gears to a safety clutch on the feed-screw of the machine. If for any reason the carriage should jam, the clutch will slip, thus preventing damage to the milling machine or motor. The motor operates through a gear reduction of



Harnischfeger Automatic Welding Machine Set up for Circular Welding



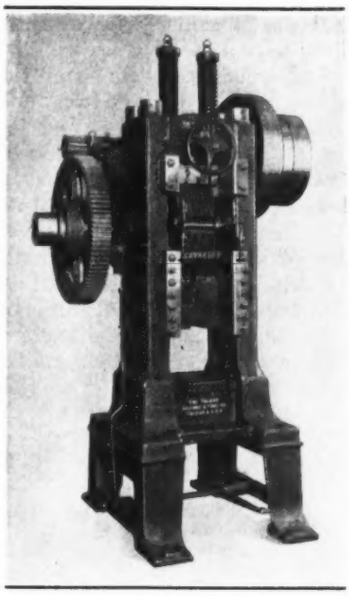
Milling Machine Equipped with Porter-Cable Quick-return Unit

2 1/2 to 1, giving a table feed of about 30 feet per minute. The control of the quick-return is by lever type switches which operate through a remote control.

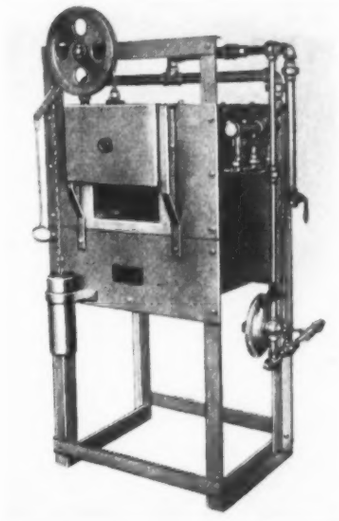
Toledo Knuckle-Joint Coining Press

The Toledo Machine & Tool Co., 1420 Hastings St., Toledo, Ohio, a division of the E. W. Bliss Co., has recently added a 150-ton size to its line of knuckle-joint presses. These presses, which are used for the sizing or cold-finishing of forgings and other coining, extruding, swaging, and cold-squeezing operations, range in capacity from 25 to 2500 tons.

The features of the new press include a rolling key clutch and refinements in details of design and construction. The uprights, crown, and bed are castings of high tensile strength and are held together by steel shrunk-in tie-rods. Previously, this press was built with a solid frame. The ability of the rods to stretch in case of a heavy blank or other mishap provides a needed measure of protection. The operating speed of the geared press shown is regularly 43 strokes a minute.



Toledo Knuckle-joint Coining Press with Tie-rod Frame



Gas-fired High-speed Hardening Furnace

High-Speed Hardening Furnace

An improved gas-fired furnace designed for rapid operation in hardening high-speed steel has been brought out by the American Gas Furnace Co., Elizabeth, N. J. The furnace is designed to use gas at line pressure and air at a pressure of 1 pound per square inch. The time required for heating to a temperature of 2400 degrees F. is two hours. The maximum gas consumption, using gas containing 525 B.T.U., is 300 cubic feet per hour, while only 125 cubic feet per hour is required to hold the furnace at a temperature of 2400 degrees F.

The burners of this furnace fire immediately under the arch, which is completely sealed, and the products of combustion are forced through vents located beneath the hearth slab. Since the hot products of combustion cannot escape through the top, a positive pressure is built up within the furnace chamber which prevents the entrance of air from the outside, even when the door is not tightly closed. With this arrangement, chimney action is entirely eliminated. The trapped hot gases beneath the arch give up their heat to the work by radiation and convection, and descend evenly around the work and hearth slab, after which they are vented beneath the hearth or through the door when it is open. The entrance to the furnace chamber is 12 inches wide by 5 inches high, and the hearth is 12 inches wide by 14 inches long.

Whitney Universal Abrasive Cutting-Off Machine

A universal abrasive cutting-off machine has been brought out by the Whitney Metal Tool Co., 107 Mill St., Rockford, Ill., which is designed for a wide range of cutting applications in production and tool-room work. It is also adapted for use in laboratories where small specimens of metal are cut for test purposes. Tubing, molding, angle-irons, and hollow shapes that are made from thin metal can be readily cut with the abrasive wheel. Hard metals, both solid and hollow, as well as glass, porcelain, stone, and various plastic materials can also be cut. A steel saw can be used in place of the abrasive wheel for cutting copper and other soft materials.

The wheel-head and motor comprise a complete unit with a

Whitney Abrasive Wheel Cutting-off Machine

graduated base for making adjustments for angular cutting up to 45 degrees on either side of the zero or right-angle point, and the vise can be tilted forward or backward. The universal feature permits pieces to be cut off to any desired angle or compound angle without swinging the material.

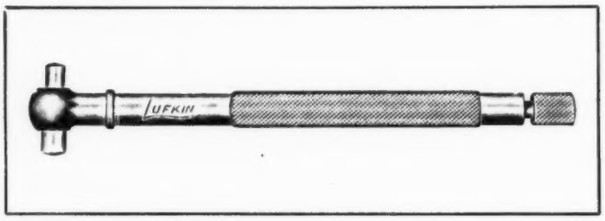
The machine can be furnished with a coolant tank in the base and a self-contained pump and motor if desired. When dry cutting, the tub-shaped casting that holds the vise is filled with water to a depth of about 2 inches. The water catches the sparks and abrasive material, and prevents them from polluting the air. When a coolant is used, it runs into the tub-shaped casting and is returned to the tank.

The vise is so designed that the clamping pressure on the work is obtained by springs which provide an equal pressure that will not mar the work or cause frail shapes and tubing to collapse. The pressure is adjusted by turning the ball handle by means of which the vise jaws are opened and closed. The abrasive wheel is 10 inches in diameter by 3/32 inch thick.

Lufkin Telescoping Gage

Measurements down to 5/16 inch and up to 1/2 inch can be made with a No. 79 AA telescoping gage being placed on the market by the Lufkin Rule Co., Saginaw, Mich. As with the larger gages of this type made by the concern, the new product consists of a knurled handle and two plungers, one of which telescopes into the other. Both plungers are held under a spring tension and are readily locked by imparting a slight turn to the knurled screw. The handle can always be locked in the center of the plungers.

This feature preserves balance and provides a gage that can be conveniently used in small openings. Heretofore, the line of Lufkin telescoping gages ranged from 1/2 to 6 inches in size.



Lufkin Telescoping Gage for Measurements as Small as 5/16 Inch

Campbell Wet Abrasive Cutting Machine for Tool-Crib Use

A small abrasive cutting-off machine that is particularly adapted for handling the variety of cutting jobs constantly arising in tool-cribs has been added to the products of the Andrew C. Campbell Division of the American Chain Co., Inc., Bridgeport, Conn. This No. 0 tool-crib cutter will handle solid bar materials up to 5/8 inch square or round, and tubing up to 1 1/4 inches in diameter, including iron, steel, brass, bronze, Monel metal, high-speed steel, porcelain, and many other materials. Hardened steel can be cut without discoloration and without drawing the temper. The cut surface is so smooth that in most cases additional finishing operations are unnecessary.

The machine can be used for either wet or dry operations, and it handles coolant without the use of a pump. The cutting is done by a revolving thin abrasive disk which picks up the proper amount of coolant from a tank at the left-hand side of the machine. The tank is provided with an adjustable float chamber by means of which the level of the coolant and the amount of coolant distributed by the revolving disk can be closely regulated.

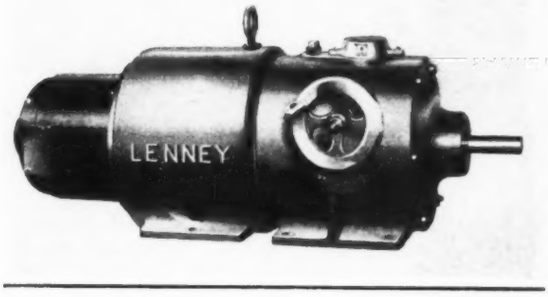
A V type holder for the material to be cut is mounted on an arm which swings from the top of the machine. On the standard machine, this holder extends 3 inches on each side of the disk. After the material has been placed in this holder with one end against an adjustable stop, the holder is fed against the cutting disk by hand. Another adjustable stop prevents the holder from being fed too far toward the cutting disk. The swing frame is provided with a guard fitted with a heavy glass window.

Extensions for the material holder can be provided in multiples of 2, 4, 6, and 8 feet for use on either or both sides of the disk. Disks up to 12 inches in diameter and from 1/16 to 1/8 inch in thickness can be used. The flanges on the spindle are 4 inches in diameter, and an abrasive disk can therefore be worn down to that diameter, plus twice the size of the material being cut.

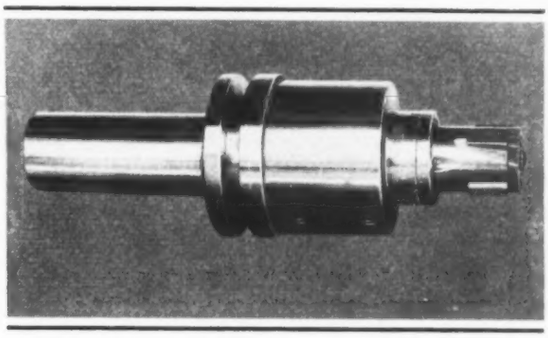
Campbell Wet Abrasive Cutting Machine for Various Materials

Lenney Variable-Speed Transmission

A variable-speed transmission which is infinitely adjustable to a fraction of a revolution between its high and low limits has been brought out by the



Lenney Variable-speed Transmission Mounted on Base with Motor



Landis Yoke-operated Collapsible Tap for Automatic Screw Machines

Lenney Machine & Mfg. Co., Warren, Ohio. This transmission is made in six sizes, ranging from 1/8 to 5 horsepower, and is designed for use in the operation of conveyors, continuous furnaces, electric welders, stokers, etc.

The running speed of the output shaft is indicated by a dial located on top of the unit, which permits setting the transmission to predetermined speeds, either before starting or while running. The speed selecting wheel is regularly located on the side of the unit, as shown in the illustration, but it can be located at any other convenient point. The transmission runs in either direction and can be used with a reversing motor or other reversing drive. The output shaft will run at the same speed in either direction and reverses the instant the input shaft is reversed.

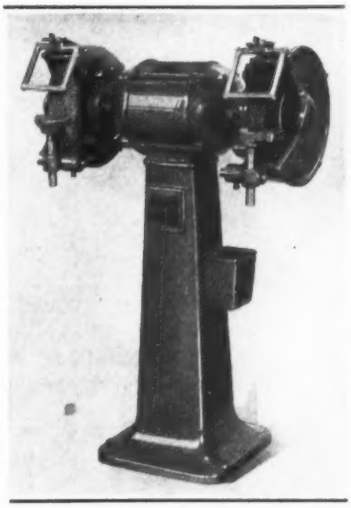
Although somewhat similar in appearance to the variable-speed transmission described in February MACHINERY, page 418, the new transmission is of entirely different design. A hardened steel roller in pressure contact with a hardened steel driving disk is used to transmit power. The contact pressure of the roller against the disk is always in proportion to the load imposed on the output shaft of the transmission. This is accomplished by means of an automatic loading device which is so constructed as to use the imposed load on the output shaft to maintain the pressure of the contact roller against the driving disk. As the imposed load increases or decreases, the pressure of the loading device is increased or diminished. The transmission maintains a constant output speed, even under severe momentary overloads.

Landis Yoke-Operated Collapsible Tap

A yoke-operated collapsible tap intended for use on automatic screw machines has recently been developed by the Landis Machine Co., Waynesboro, Pa. This tap is a modification of the Landis Style LT collapsible tap which has been on the market for a number of years. As shown in the accompanying illustration, the new tap is fitted with two flanges against which forked yokes attached to the machine operate for expanding and collapsing the chasers.

The chasers are collapsed when one yoke comes in contact with the face of the flange near the front or chaser end of the tap upon completing a thread of the desired length. The chasers are then reset to the tapping position by the second yoke coming in contact with the flange near the shank of the tap upon the return of the machine spindle.

The head is made detachable, as on all Landis collapsible taps, so that heads of several sizes can be applied to the same body. The tap can be furnished in all sizes ranging from 1 3/8 to 12 inches. It can be used either as a stationary or a rotary tap.



Clark Grinder of Two-horsepower Rating

Clark Two-Horsepower Grinder

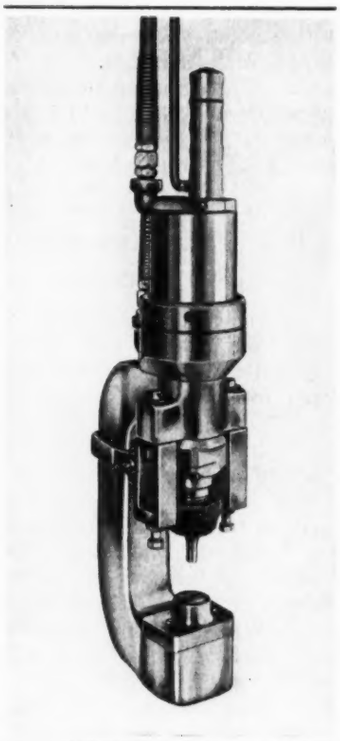
A floor type grinder of two-horsepower rating has recently been added to the line manufactured by the James Clark, Jr., Electric Co., 600-640 E. Bergman St., Louisville, Ky. This machine is equipped with a push-button control provided with overload protection. Other standard equipment includes safety guards that are adjustable for wheel wear, non-shatterable glass eye-shields, and tool-rests that can be adjusted both horizontally and vertically. An exhaust opening can be furnished in the bottom of the wheel guards.

The motor is totally enclosed and the rotor shaft is mounted

in heavy-duty ball bearings. The motor is built for continuous duty at 1750 revolutions per minute and will stand a momentary overload of 100 per cent. The motor frame is made of small diameter to permit maximum wheel wear and to provide a large amount of work clearance.

Hannifin Portable High-Speed Hydraulic Punch

A high-speed portable hydraulic punch which weighs 59 pounds and has a capacity of 17 1/2 tons has been brought out by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill. Interchangeable dies provide for punching holes of various diameters up to 7/8 inch in drawn and formed parts of sheet steel up to No. 10 gage. The yoke of the punch has shoulders which provide for the attachment of an adjustable stripper designed to automatically remove shells of various depths.



Hannifin Portable High-speed Hydraulic Punch

The punch is operated by hydraulic power from a Hannifin Hy-Power hydraulic pressure generator consisting of a motor-driven oil-pump, automatic electric valve unit, and oil reservoir. The portable punch is connected to the pressure generator unit by high-pressure hose and an electrical control cable. The operating cycle is approximately two seconds.

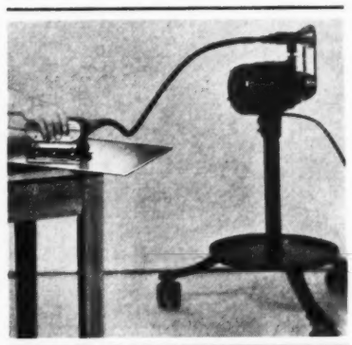
A push-button on the handle of the punch controls the entire operation of the unit. When the control button is depressed, the following cycle automatically takes place: (1) Rapid advance stroke until the die touches the piece; (2) automatic high pressure to punch the hole; (3) automatic reversal; (4) rapid return to starting position; (5) idling of the oil-pump at zero pressure between cycles.

The punch will not repeat, but completes one cycle and stops. The control button must be released and pressed again for another cycle. Release of the control button at any point during the operating cycle provides an instantaneous safety stop and an automatic return to the starting position.

Tek-Lace Non-Metallic Belt Lacing

A non-metallic lacing for fastening flat belts or V-belts has been brought out by the Sudbury Laboratory, P. O. Box 934, South Sudbury, Mass. This lacing is only 0.055 inch in diameter, but has a tensile strength of 100 pounds, which is 50 per cent greater than the Federal specifications for rawhide 1/4 inch wide by 1/8 inch thick. A 3-inch belt fastened with this lacing has a tensile strength of 2000 pounds at the joint. The small holes that it requires are pierced through the belting without cutting the fibers, thus avoiding weakening of the belt.

This lacing is set into the belt instead of standing out above the surface. Thus the joint is smooth and flexible, so that the pulleys and the lace itself are protected from undue wear.



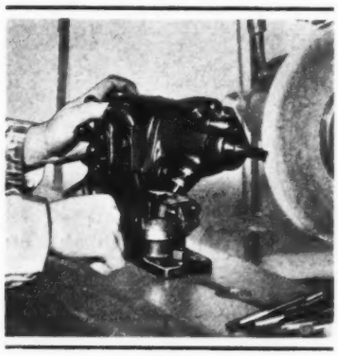
Sterling Electrically Driven Sander

Sterling Electric Sander and Finisher

An electrically driven sanding and rubbing device has been brought out by the Sterling Products Co., 314-320 Curtis Bldg., Detroit, Mich., to supplement the air-driven model described in April, 1936, MACHINERY, page 564. The new model is driven by an electric motor through a flexible shaft as shown in the illustration. In the metal-working field, it is intended for use in finishing machine tool parts, automobile bodies, railway cars, etc.

The sanding pad of this device has a travel of 5/8 inch and can be reciprocated at various speeds from 1750 to 2800 times a minute to suit the work being performed. The floating principle of the air-operated sander has been adopted in the new model, flexible rollers of composition rubber and fabric being attached in a floating manner to the sander block by means of pins. With this construction, the sander block has a free movement that enables it to be applied conveniently to either flat or curved surfaces.

The device is intended for either wet or dry sanding and finishing. There is a water connection to a series of openings at each side of the block through which a spray may be delivered that is readily adjustable to suit requirements. From one to five sheets of abrasive can be attached to the sanding pad at one loading.



Fixture Designed for Regrinding Taps of All Types

Tap Chamfering Fixture

Taps of any type and size up to and including 1 1/4 inches, irrespective of the number of flutes or the length of the shank, can be sharpened by means of a fixture recently brought out by the Detroit Tap & Tool Co., 8432 Butler St., Detroit, Mich. This fixture is said to insure the regrinding of taps concentric with the shank and to eliminate difficulties in tapping that arise from inaccurate flute spacing during regrinding operations.

The tap being ground is rotated on an eccentric axis, indexed by means of a finger, and registered with the reground flute face. This method eliminates the necessity of providing separate cams for each type of flute and for different numbers of flutes. Spring collets are used to hold and locate the tap. This insures concentricity and facilitates the sharpening of taps on which the center holes have been ground away. The amount of eccentricity or relief can be quickly regulated by means of a graduated adjustment without the need of separate cams.

In grinding, a light pressure of the hand is applied to bring the finger against a stop on the fixture while rotating the tap by means of the handle. This imparts an oscillating motion to the tap. The fixture is completely universal in that it can be used for the sharpening of all taps, including taper, plug, and bottoming types. The fixture can be mounted on any grinding machine in either a right- or a left-hand position, and it is adjustable for height.

Wells Metal-Cutting Band Saw

A metal-cutting band saw designated as No. 5 has been developed by the Wells Mfg. Corporation, 315 Seventh Ave., Three Rivers, Mich., to replace the No. 4 machine. This machine will cut round stock 5 inches in diameter and flat stock 5 by 10 inches. It is portable and occupies a space of 21 by 50 inches.

Pipe, angle-irons, mill shapes, round bars, and, in fact, practically any material within its capacity can be cut on this machine. All moving parts are equipped with ball bearings, and the gears operate in oil. The motor is of 1/3 horsepower.

Metal-cutting Band Saw Brought out by the Wells Mfg. Corporation

One of the New G. E. Motors of Open Sleeve-bearing Design

General Electric Squirrel-Cage Induction Motors of Improved Design

Riveted-frame, squirrel-cage, polyphase, induction motors of a new design, in sizes from 1 to 15 horsepower at 1800 revolutions per minute, have recently been placed on the market by the General Electric Co., Schenectady, N. Y. These new motors are available with a variety of electrical and mechanical modifications. They incorporate improvements in stator-coil insulation, frame construction, and other features of design.

Coordination of the design permits different modifications of the motors to be used interchangeably for various applications requiring open, sleeve- or ball-bearing, enclosed, enclosed fan-cooled, splash-proof, vertical motors, etc. As a result of this adaptability, many special requirements can be met with the standard line.

The stator-coil windings are of the random-wound type with the joints fused at the connections instead of soldered. Recently developed insulating materials and processes are utilized that eliminate the need of taping

the end windings. The insulation is highly resistant to moisture, mild acids, alkalies, oil, and abrasion.

A new riveted-frame construction and end frames made of malleable iron with integrally cast feet contribute to the strength and rigidity of the motors and thus provide increased resistance to vibrating and shock loads. The cast-iron end shields are designed to maintain accurate bearing alignment and a uniform air gap. The illustration shows a typical motor of the new line. It is an open, horizontal, sleeve-bearing, general-purpose motor.

Wright Professional Drawing Stand

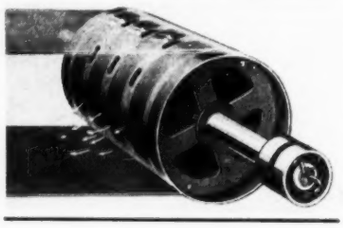
To meet the requirements of many large companies for an efficient drawing stand for use in making small drawings under the 20- by 26-inch size, L. G. Wright, Inc., 5207-15 Euclid Ave., Cleveland, Ohio, has developed the Wrigraph drafting stand here illustrated. The drawing table of this stand can be equipped with a small drafting machine for making the many small drawings required in every large drafting-room, and will meet all the drawing requirements of many small plants.

The stand is built of oak and is securely cross-braced. The drawing board can be tilted 90 degrees and can be clamped at any angle. The height is adjustable from 33 to 45 inches. Large star-wheels are used to clamp the posts securely.

Wrigraph Drawing Stand for Use in Making Small Drawings

Stearns Magnetic Separator Pulley

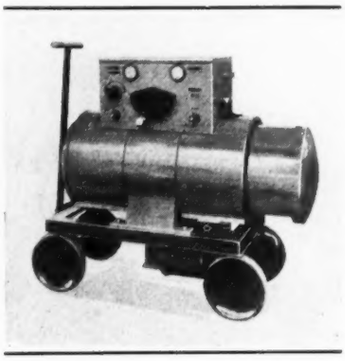
An unusual type of ventilating system is incorporated in a magnetic pulley for conveyor belts brought out by the Stearns Magnetic Mfg. Co., 604 S. 28th St., Milwaukee, Wis. This pulley is intended for use in reclaiming brass from steel and iron chips or scrap. In this pulley, the action of the conveyor belt is employed, as indicated in the illustration, to cause air to circulate around the magnetizing coils, thus reducing their temperature and consequently increasing their magnetic pull from 25 to 50 per cent. Through the system of specially designed air slots, the air is forced into the radiating areas of the pulley by the belt at the upper side of the pulley, and is drawn out by the action of the return belt at the lower side of the pulley. This system provides a continuous circulation of fresh air through the pulley.



Stearns Magnetic Separator Pulley

Noel "Speedarc" Welders

Unusually fast operation is an advantage claimed for a line of Noel welders being placed on the market by the Ideal Electric & Mfg. Co., Mansfield, Ohio. The feature of these welders is that the armature windings extend out from the main field structure and underneath a second or auxiliary field structure. The advantage of this design is that the main field and its flux do not change in the operation of the welders.



Noel "Speedarc" Welder Built in Four Capacity Ratings

The auxiliary field is excited by a heavy series winding, so connected that it generates a "bucking" voltage in the armature. The amount of this bucking voltage depends upon the current, with the result that the net applied voltage at the arc decreases as the current increases, and when the current drops, full voltage is instantly available to maintain the arc.

It is stated that oscillograph curves have shown that these welders return from short circuit to the normal welding current in less than three-fourths of a cycle of a 60-cycle timing wave (about 0.01 second) with no under-ride. The welders are available in ratings of 125, 200, 300, and 400 amperes.

Vickers Hydraulic Feed Control Panel

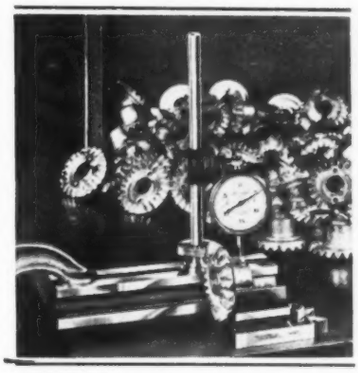
A feed control panel for "rapid traverse and feed" hydraulic circuits employed on machine tools for such operations as drilling, reaming, boring, turning, and milling has been brought out by Vickers, Inc., 1400 Oakman Blvd., Detroit, Mich. This control is designed

to provide any cycle sequence, made up of rapid advance, adjustable coarse feed, adjustable fine feed, and rapid return motions.

The main internal control valve is actuated by one of three methods—manually by the lever near the bottom of the case, mechanically by trip cams on a moving platen or head containing a plunger roller, and electrically by energizing solenoids mounted behind the unit.

Starting of the rapid advance cycle can be accomplished by manual movement of the control lever or remotely by means of a push-button or other electrical contact. Change from the rapid advance to the feeding rate is normally accomplished by a cam or cams which come in contact with a plunger roller on the control. As shown in the illustration, the control panel is provided with two locking type dials. These dials are graduated to provide means for closely adjusting the two feed rates. The dial at the left controls the fine-feed adjustment, while that at the right controls the coarse feed. These dials provide infinitely variable feeds within their range. Adjustments can be made during the actual feeding operation. The acorn nuts at the centers of the dials can be tightened to prevent settings being changed accidentally.

Vickers Feed Control Panel for Hydraulic Circuits



Using Starrett Dial Test Indicator and V-block and Clamp

Starrett Tools for Production Inspection

The illustration shows two tools recently developed by the L. S. Starrett Co., Athol, Mass., being used for checking the hub diameter of bevel gears. These tools comprise a No. 665 dial test indicator, and a No. 567 V-block and clamp which were described in September MACHINERY, page 66. The tools can be used separately for unit operations.

The dial test indicator is furnished with a right-angle arm that provides adjustment beyond that obtainable with the horizontal arm. Either arm can be removed from the standard and used in the toolpost of a lathe if desired. Small blocks which fit into the base provide a guide for checking against the edge of a T-slot or work plate.

The V-block sides are ground parallel and the V-grooves are ground central and parallel with the sides and base. One end of the block is stepped down and is provided with a groove at right angles to the base in which shouldered studs, round pins, and similar pieces can be clamped for light milling, drilling, and grinding operations.

"Ful-Vue" Goggle for Eye Protection

Self-adjusting nose pads, six-curve Super Armorplate lenses, and non-corrosive wire-mesh side shields designed to protect the eye against particles striking from any direction are features of the "Ful-Vue" goggle recently added to the line of eye protection equipment made by the American Optical Co., Southbridge, Mass.

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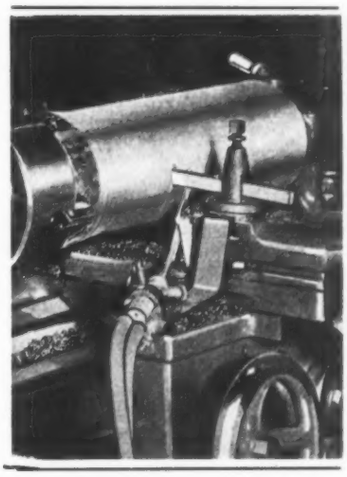
Lectures on Welding

Ten lectures on the fundamental principles involved in welding will be given at the Polytechnic Institute of Brooklyn, 299 Livingston St., Brooklyn, N. Y., Tuesday evenings, beginning November 10. Each of these lectures will be by a recognized authority.

* * *

Demonstration of Stellite J-Metal Tool

One of the features of the Haynes Stellite Co.'s exhibit at the National Metal Exposition in Cleveland during the past month was a demonstration of a Stellite J-Metal tool cutting a steel billet while the tool was continually kept at a red heat by means of an oxy-acetylene flame. This demonstration attracted a great deal of attention and gave ample evidence of the important property of red-hardness of J-Metal, which is a non-ferrous cutting alloy composed of cobalt, chromium and tungsten.



Red-hot Stellite J-Metal Tool Cutting a Steel Billet

NEWS OF THE INDUSTRY

California

CUTLER-HAMMER, INC., 12th and St. Paul Ave., Milwaukee, Wis., manufacturer of electric control apparatus, has opened a new plant at 970 Folsom St., San Francisco, Calif., with R. R. CROOKE in charge.

Great Britain and Canada

WODACK ELECTRIC TOOL CORPORATION, 4627 W. Huron St., Chicago, Ill., has recently completed arrangements for the manufacture of Wodack portable electric tools in England. The tools will be manufactured by the CLIMAX ROCK DRILL & ENGINEERING WORKS, LTD., 4 Broad St. Place, London, from designs and patterns used at the Wodack plant in Chicago. Distribution of the tools by the Climax sales organization will cover Great Britain and the British Dominions, with the exception of Canada.

E. H. JONES, LTD., of London, England, dealers in machine tools, announce that after twelve years at Baldwin Terrace, Wharf Road, Islington, the firm has moved into larger quarters at The Hyde, Hendon, London, N.W. 9. The new premises have a floor area of 40,000 square feet, enabling a large stock of machine tools to be carried.

D. M. FRASER, president of D. M. Fraser, Ltd., of Toronto, Canada, has been appointed motor sales representative for Canada by the Ohio Electric Mfg. Co., Cleveland, Ohio.

Illinois and Indiana

W. O. WILL, formerly connected with the engineering department of the Illinois Tool Works, has joined the sales staff of the Tool Equipment Sales Co., 4625 Fulton St., Chicago, Ill.

HARRY C. HICKS has been appointed sales manager of the Chicago district for the New York Belting & Packing Co., Passaic, N. J. His headquarters will be at 3550 S. Morgan St., Chicago.

WALTER L. LOEGLER has been appointed manager of the Chicago office of the Warner & Swasey Co., Cleveland, Ohio, after having been in charge of the company's Dayton territory for nine years. Mr. Loegler has been associated with the company since 1912, when he went to work in the shops as an apprentice. He joined its sales organization at Boston in 1919, and from 1922 to 1924 was sales correspondent. In 1924 he was made manager of the Philadelphia territory, which position he held until he was transferred to Dayton in 1927. Mr. Loegler succeeds G. KOCHENDERFER as manager at Chicago. ALBERT SCHNAITMAN, who has recently been associated with the Dayton office, has been made manager at Dayton to succeed Mr. Loegler.

Walter L. Loegler, Manager of the Chicago Office of the Warner & Swasey Co.

WENCO MFG. CO. announces the removal of its offices and factory to 1130-1134 W. Hubbard St. (formerly Austin Ave.), Chicago, Ill.

C. E. CHATFIELD has been appointed sales representative in Indiana of the DELTA-STAR ELECTRIC CO., 2400 Block, Fulton St., Chicago, Ill., with headquarters at 503 Illinois Bldg., Indianapolis.

Michigan

PROFESSOR ELIHU THOMSON, one of America's foremost pioneers in the field of electrical science, and holder of more than 800 patents, was honored October 16 by the Detroit section of the American Welding Society, which dedicated its program to the fiftieth anniversary of one of Professor Thomson's inventions—that of resistance welding. The anniversary program was presented in the Detroit Edison Auditorium. Professor Thomson, who is now in his eighty-fourth year, was one of the founders of the General Electric Co.

W. P. LOTZ has joined the Fellows Gear Shaper Co., Springfield, Vt., as assistant sales manager, with headquarters at 616 Fisher Bldg., Detroit, Mich. He recently returned from the Far East, where he acted as special representative of the Pratt & Whitney Co., Jones & Lamson Machine Co., Landis Tool Co., and National Automatic Tool Co. Mr. Lotz was formerly manager of the New York office of the Kearney & Trecker Corporation.

GUST HEIDRICH has been appointed factory manager of the Cross Gear & Machine Co., 3250 Bellevue Ave., Detroit, Mich.

WALTER N. LARKE, for the last two years assistant superintendent of the engine division of the Buick Motor Co., Flint, Mich., has been made superintendent, and will be succeeded as assistant superintendent by FRED W. LETTS, for the last two years general foreman of the crankshaft department.

Walter N. Larke, Superintendent of Engine Division, Buick Motor Co.

Fred W. Letts, Assistant Superintendent of Engine Division, Buick Motor Co.